SCIENCE

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*A NATURAL HISTORY SURVEY OF MICHIGAN.**

IN Michigan, as in many other States, the desirability, or, perhaps better, the necessity of a survey of the natural resources of the State was early recognized. In 1837 Governor Mason approved an act providing for a geological, zoological, botanical and topographical survey.

It is of interest to note that the early surveys, or explorations, that followed were not limited to a study of the mineral wealth of the Territory. The flora of the regions visited occupied no inconsiderable part of the time and attention of the explorers, and Dr. Houghton's plants in the University herbarium are, many of them, after the lapse of over half a century, still among the finest in the collection. Economical considerations, however, soon led (1840) to the repeal of those portions of the act that pertained to zoology and botany, and but little more was undertaken in this direction until the survey of 1859 and 1860, the report of which, transmitted by Professor Winchell, in 1860, included Geology, Zoology and Botany, the zoological part consisting of an enumeration of birds, reptiles, batrachians and mollusks, while the part devoted to botany includes a list of vascular plants, with remarks on distribution and economical relations.

Since that date the survey has been geo-

*Address by the retiring President of the Michigan Academy of Science, at Ann Arbor, April 1, 1898.

logical. Its scientific and practical value are not questioned, but it is at least an open question whether a return to the more comprehensive plan of the original promoters of the survey is not desirable, and whether there is any reason to suppose that at the present time there are under the earth in Michigan things about which it is more important for us to know than it is to know about those in our waters and in our forests.

The practice of other States may be expected to throw some light on this question. Our neighboring State of Ohio has published, as part of its voluminous report of the Geological Survey, a large volume on the zoology of the State, in which the honored and lamented Chief of the Survey, Dr. J. S. Newberry, takes occasion to speak at some length of the educational and practical value of this part of the work, and Indiana, in its survey by counties, has made large provision for the study of the plant-life of the State, with the object, among other things of preserving, for future generations, a permanent record of the flora as it now exists.

New York State many years ago made appropriations for the natural history side of its survey, and has continued this liberal policy to the present time, and the recent reports of the Geological Survey of New Jersey give large space to the report of the botanist, while Pennsylvania has recently organized a comprehensive survey of its forest resources, and States farther south have set an example which we may well consider. The work of the Alabama Biological Survey comes to us as an example, with the ripe fruits of the long and well-directed activity of that rare scientific genius, Dr. Charles Mohr, and with a corps of younger men eagerly pushing forward into fields that still in Michigan wait our explorations. Can it be that the atmosphere of the Gulf is more invigorating to workers in science than that of the Lakes?

But in some of the newer States of the West we find a still fuller realization of the broad views and more comprehensive plans that, partly in the light of experience and partly as the result of a growing conviction of the inter-dependence of all organic science, have been embodied in the practical workings of the State Surveys. In Minnesota the Survey was organized as late as 1872. It was named—and the name is significant—The Geological and Natural History Survey of Minnesota, and was placed under the direction of the Board of Regents of the University. "The Survey is comprehensive in its scope. The fields of investigation named in the original act are geology, botany, zoology and meteorology."* * * * The results of the investigations already made include so many bulletins, scientific papers and reports that an enumeration would occupy too much time, but they stand as witness to the liberality and breadth of view with which this Survey has been conceived and so far carried out, and we may congratulate the people of our vigorous sister State on "the steadiness of purpose that has held the Geological and Natural History Survey of Minnesota to its work."

It is perhaps unnecessary to go further, although other examples are not wanting of the fact that States characterized by generous and enlightened views have provided, and are now providing, means for Surveys not limited by the bounds of a single science, in which plant and animal life are recognized as being quite as worthy of study as the mineral wealth of the State.

Unfortunately, this is not true of our own State. Former papers before this Academy have not failed to emphasize the patent fact that Michigan, so far from being a leader among the States in organized biological work, conducted by the State, is far behind

*Hall, C. W. The University of Minnesota, an Historical Sketch. Minneapolis, 1896.

others that started later; and the fact that a special committee appointed for the purpose of securing appropriations from the Legislature for printing the publications of the Michigan Academy of Science has thus far met with no success may well lead to careful seeking after the cause of this apparent indifference. Are we producing nothing worthy of the attention of the State? Or is our work good enough in its way, but of no money value, and consequently something that the public money ought not to be spent for? Or is there some occult reason, not yet suggested, for a condition of affairs that, to say the least, is not creditable to the State of Michigan or to the scientific workers within its borders?

I am frank to say that, in my own judgment, we have not always in the past acted with consummate wisdom when we have sought to secure the cooperation of the State in enlarging the scope of the public surveys; but, without attempting to review here a history more instructive than flattering, I may be permitted to express the conviction that in the immediate future, by unitedly and at once taking up certain specific problems that are recognized by every one as being of paramount importance from an economical point of view, the study of which, at the same time, affords full scope for scientific investigation, we shall be taking the surest way to the end in view.

We have in Michigan to-day two such problems presented by our forests and fisheries. It is to the former that I wish for a short time to direct your attention. The facts are familiar, but I am sure that those who have already done so much in this direction are the very ones who will most gladly listen, if by any means we may at length see more clearly and take some actual forward steps toward the working out of the great problem involved in the future of our Michigan forests.

The pine belt of Michigan formed in its day part of one of the finest natural forests on the face of the earth, with its magnificent cork pines hundreds of years old, towering above equally beautiful specimens of sugar maple, basswood, rock elm and other deciduous trees, constituting the beautiful growth of hard wood that still covers so many square miles of northern Michigan. It was a forest that did not grow in a day. It takes about two hundred years for a white pine tree to come to maturity, and many of those cut by Michigan lumbermen were much older, so that when lumbering was commenced in the State one of its great natural resources that had been hundreds of years in making changed rapidly into another form of wealth and disappeared. The later history is familiar to you. Year after year saw gigantic lumbering operations farther and farther extended, and fearful fires sweeping through the *débris*, carrying thousands of acres of virgin forest to its doom, and with it the homes and hopes of settlers, leaving such a picture of desolation as haunts the memory of one who has passed through it, all the more appalling because of the tragic wreck of human interests, and the apparently hopeless outlook for the future.

It is well for us servants of the State, even if devotees of pure science, to try and form some conception of the magnitude of an interest that has been so conspicuous an element in the material development of the Commonwealth. Briefly, then, as early as 1881 the aggregate value of the forest products of the State was estimated to have reached more than a billion dollars, and, now after half a century of lumbering, and after the closing of one great mill after another and removal of the operators to other fields, the State of Michigan alone produced in 1897 2,335,000,000 feet of lumber and 1,284,000,000 shingles. These figures may produce no real conception of what they stand for, but they may help us

in some measure to appreciate the fact that the prosperity of the State has been due very largely, if not chiefly, to its forests, and that the State must inevitably suffer a loss not easily estimated through the certain diminution of this great source of wealth.

We may now raise the question whether all this is any concern of the State, whether as a Commonwealth it is under any obligation to seriously take up the question of forest reserves and State control, and, if so, what can be done? And, in the second place, we may inquire whether individual citizens, and especially those who have had scientific training, have a duty in the premises.

There is a school of sociologists who hold that the functions of government should be reduced rather than extended; that they govern best who govern least; and that "the good of the nation is attained by inactivity rather than by active exertion of the government, by allowing the individual to work out his own salvation (or damnation) amid the free and unrestricted play of natural forces, rather than making them do so." Such *laissez-faire* doctrines, however, will hardly appeal to that more enlightened and healthy public sentiment that regards the function of government as legitimately exercised "wherever cooperation of the whole will accomplish the end aimed at by society better than individual effort."*

Now, as pointed out by Dr. Fernow, from whom I have already quoted, government has what may be called providential functions in regard to natural resources. It is the "representative not only for communal interests as against individual interests, but also of future interests as against those of the present. * * * Its activity must be with regard to continuity, must provide for the future, must be providential," and this in the case of such a natural resource as the one under consideration is possible only under the supervision of permanent institutions, with which present profit is not the only motive.

These principles embodied in the scientific forestry of the Old World have resulted in the establishment of a well-nigh perfect system under which in France the sandy wastes of Gascony have been covered with productive forests, and denuded mountain slopes, the play of destructive torrents, have been clothed again with their protective covering of sod and trees; while in the German Empire a clear annual revenue of $40,000,000 shows something of what is practicable under State control of forest property.

In the New World, in recent years, one State after another has come to recognize the necessity as well as the reasonableness of government care of the forests, and in several States important Legislative enactments have defined the policy and rights of the Commonwealth in this direction.

In the State of New York a law enacted April 25, 1895, provides for a Commission of Fisheries, Game and Forests, with power to appoint thirty-five foresters, whose duty it is to enforce all laws and regulations of the Commission for the protection of fish and game and for the protection and preservation of the forest reserve and all rules and regulations for the care of the Adirondack Park. The law provides further for the care and superintendance of the forest preserve, for protection against fire, actions for trespasses, and for the purchase and taxation of lands belonging to the State.

The New York State Legislature last year appropriated $1,000,000 for the purchase of land in the Adirondack region, and the State now owns 800,000 acres (out of the 2,500,000 acres) of forest land in that section. This year $500,000 will be placed in the hands of the Forest Preserve Board to continue the purchase of forest lands,

* Fernow, B. E., SCIENCE, Vol. II., p. 258.

and part of this sum, it is expected, will be expended in the purchase of 25,000 acres that will be given in trust to the authorities of Cornell University for twenty-five years, with the aim of having an experiment in forest preservation and culture tried.*

It is thus with well-matured plans, looking far into the future, that the State of New York has made liberal and far-sighted provision for its forest interests, finally calling to the aid of the State the services of the University and giving a quarter of a century in which to conduct an experiment that can hardly fail to be productive of important results.

The Legislature of Pennsylvania, at different times within the past few years, has passed laws establishing and prescribing the duties of a Forest Commission to report upon the condition of the slopes and summits of the important watersheds of the State, the amount of standing timber, the part or parts of the State where each grows naturally, and to suggest measures for maintaining a proper timber supply. Provision is further made for the enforcement of laws designed to protect forests from fire and for the preservation and increase of the timber lands of the State and for securing forest reservations adjacent to waters draining into the Delaware, Susquehanna and Ohio rivers.

Most instructive, perhaps, on account of similarity of conditions, is the recent history of forest legislation in Wisconsin. The Legislature of 1897 passed a law authorizing the Governor to appoint a commission consisting of three members to devise and draw up a plan for the organization of a State forestry department. The plan is to include provisions for the reservation by the State of all lands which are better fitted for the growing of timber than for agricultural purposes, the purchase of similar lands abandoned by their owners, and the management and replanting of forests according to the principles of scientific forestry. They are also to draw up a plan by which the forestry department may be from the first self-supporting and in time become a source of revenue to the State.

It was provided that the commission should receive no compensation, but the services of a competent expert connected with the Forestry Division at Washington were secured, and $500 toward his actual expenses were provided by the State Geological and Natural History Survey. Mr. Filibert Roth, who was detailed for this work, entered upon his task with characteristic energy, and in a month's journey visited 27 counties with a total area of 18.5 million acres. His report* is of special interest, giving, as it does, a remarkably clear statement of the condition of things over an area embracing fully half of the State of Wisconsin, including 8.5 million acres of cut-over land, most of which is burned over and largely waste, and on which some twenty billion feet of pine has been destroyed by fire. The value of the timber product of former years is suggested by the statement that "the forest industries have built every foot of railway and wagon road, nearly every town, school and church, and cleared half of the improved land in northern Wisconsin."

The discussion of the future of this great area, once a natural forest, now largely a wilderness, necessarily involves great uncertainty. Trees cannot be made to grow by an act of legislation, and the Legislature itself is an uncertain factor. Mr. Roth proceeds to show that in Wisconsin "the hardwoods, though perfectly able under normal conditions to hold their own and continue as forests, have not done so," and "that hemlock has failed to reproduce itself for a long time," while the white pine, is, per-

* New York *Tribune*, February 19, 1898.

* Preliminary Report on Forest Conditions in Northern Wisconsin. Washington, 1898.

fectly capable not only to continue as a forest, but also to re-clothe old burned-over slashings on all kinds of soil. But it is equally certain that the great mass of pine slashings have remained and will continue to remain barren wastes, and that of the 8,000,000 acres of cut-over lands in north Wisconsin not one-tenth is stocked with growing timber. And the swamp woods have no future, for it is here among the tall marsh grass and masses of dead poles that most of the fires start.

"In this way an area now nearing 8,000,000 acres, and rapidly increasing in extent, remains unproductive. Counting only 20 cubic feet, or 100 feet B. M., as the annual growth per acre on lands entirely without any care or protection against fire, the State of Wisconsin loses annually by this condition of things 800,000,000 feet B. M. of marketable saw timber; nor is this all, for even with primitive management this amount could be largely increased.

"The assertion that this land is needed for agriculture, that it soon will all be settled, and that even the sandy soils produce potatoes and are profitably farmed by improved methods, may well be answered by a concrete case. The old settled counties Waushara, Adams, and Marquette have an aggregate area of 1,144,000 acres; their improved land amounts to 340,000 acres, leaving fully 70 per cent., or 804,000 acres, in brush and waste lands. In 1895 these counties supported wood industries whose products amounted to the pitiful sum of $13,000, and probably the material for these was imported, instead of having 80,000,000 feet of pine to sell, which under simple methods of care might have been derived from these brush and waste lands."

It will be seen that in this preliminary survey and report an important and valuable contribution has been made, which has opened the problem for further investigation, demonstrating meanwhile the extent of the interests that are involved in its practical study. The Forestry Commission of Wisconsin fully realizes this, and is actively at work with plans for the future.

The similarity of conditions in the two States and the solid progress already made in Wisconsin suggest that we can probably do no better at present than to adopt substantially the same measures, namely, to obtain through the State Legislature enough to pay for the services of an expert for, say, six months—long enough to give sufficient data to go to work on—and meanwhile secure also, through the Legislature, the appointment of an unpaid State Forestry Commission to formulate plans for the future. Such a course as this can not possibly be open to the charge of political jobbery; the initial expense to the State is so little as to be hardly worth mentioning, and the end to be obtained is of such far-reaching importance as to warrant, or rather imperatively demand, the earnest work and personal sacrifice that will be involved in this patriotic effort to restore in some measure the forest wealth of Michigan and to make forever impossible the frightful waste of natural resources that has been so conspicuous a factor of our recent history.

It will naturally be asked: Is this all that the Michigan Academy of Science is to do in formulating plans for a Natural History Survey of the State? Workers, many of us, in pure science, are we to rest satisfied with merely formulating a plan by means of which the material interests of the State are to be subserved? Ought we not rather to develop a comprehensive plan by means of which biological relations of every kind shall be brought under scientific investigation? Shall we not leave practical matters to practical men and give ourselves to that to which we were called—our laboratories, our students, and the pursuit of science for its own sake?

Such questions lead finally, as it seems to

me, to the answer that the interest of one is in the end the interest of all. Scientific investigation, in Michigan at least, is to a great extent dependent on means provided by the people of the State, who are paying, generally with cheerfulness, sometimes with more or less questioning, for the equipment of the laboratories in which we work. Such is our dependence, let us frankly acknowledge it, and hold ourselves ready to make such return as we are able. On the other hand, the people of the State are dependent—more so, perhaps, than is sometimes admitted—on trained scientific men for the working-out of nearly every problem affecting their material interests. There is not a practical man in Michigan competent alone to successfully work out the problem as to just what the State ought to do in the preservation and profitable management of its forests. Here the services of trained scientific experts are indispensable, and fortunately this University was, eight or ten years ago, engaged in training the man who is now fitted to render this service and stands ready to do so.

In the second place, a full recognition of material obligation and the taking-up of just such practical problems as this will not hinder, but will pave the way for, the more extended investigation of the natural history of our State that we all hope to see accomplished. It is, I am convinced, the part of wisdom to begin our Natural History Survey of Michigan with this great and pressing problem; but no one could think for a moment that it should end there. Here, as elsewhere, means are certain to be forthcoming as it becomes evident that they are deserved, and I believe that we may today begin to plan for just such a comprehensive biological survey of the State as would satisfy the most extended and exacting scientific requirements, assured that in due time we shall have full means for its accomplishment.

I should hardly think of attempting offhand to draw up a requisition or to unfold a comprehensive plan for such a survey. But there are certain principles, or facts, that through their inherent reasonableness must, I think, command general assent and upon which we may proceed until we can see further.

First, there ought to be within the State a collection of books of such extent that the literature of any branch of natural history may be within the reach of specialists, without the necessity of borrowing or undertaking long and expensive journeys. Such collections of books are a necessity and the development of scientific work in Michigan will be advanced or hindered according as they are or are not provided. We can not have these books in a day; but we can and ought to make their necessity known, and to use every legitimate means to secure them. The State of Minnesota, in connection with its Natural History Survey, appropriates year after year what would seem to us a munificent sum for the purchase of books that go into the University library and there become permanently available for purposes of research.

Secondly, there ought to be provision for the publication, by the State, of all material that has assumed sufficiently complete shape to be an actual contribution to our knowledge of the various plants and animals within our borders. Not a little valuable material, to the knowledge of the writer, lies packed away in the laboratories of the State that should be published as a part of its Natural History Survey, that with the assurance of publication in creditable form would be steadily growing, instead of remaining at a stand-still. It is, I think, the duty of our Academy to press this upon the attention of the State government until the want is supplied.

In the third place, passing now to matters that may be determined largely by in-

dividual agreement rather than by State action, we may profitably aim both at greater specialization and more intelligent cooperation. When one has made himself a thorough student in any special field it would seem both courteous and expedient for all of us to recognize that field as his, to send him material that falls into our hands, and to cooperate with him in every way in our power. I do not mean, of course, that a summer or two of amateur work constitutes a claim to preëmpt any special group or subject, nor, on the other hand, that any one should be precluded from doing his utmost in any field whatever to which his choice may lead him, but that we ought to recognize the necessity of a division of labor, and also the fitness of looking to those who for a score of years or a lifetime have carefully worked some restricted field as the natural depository of material, and authorities to whom we may go for help and to whom we may gladly render service in their further studies.

Lastly, the question of organization—by no means an easy one—is best approached by an attentive study of the recent experience of other Commonwealths. If we were starting without traditions, with the virgin soil of a new territory open to us, it would, perhaps, be hardly possible to devise an organization with a more comprehensive, practical and reasonable working basis than that of the State of Minnesota. But we are not starting that way. Our State Survey has its traditions. We have several centers of scientific work instead of one and it is inevitable and desirable that, directly or indirectly, they should have a hand in much at least of the scientific work that in the future is undertaken by the State.

This condition of affairs would perhaps suggest a form of organization similar to that of Indiana, in which a Biological Survey was inaugurated by the Academy of Science five years ago. This has since been adopted by the State, and is quite distinct from the Geological Survey, though working in entire harmony with it, the State Geologist being an active member of the Academy. "In a very short time," says Professor Stanley Coulter, "the work in this Survey was felt to be of great importance to the State. An application to the Legislature secured an annual appropriation of $600 for the publication of the proceedings. The Academy furnishes the material and the editorial supervision without cost to the State. The State, however, prints and provides for the distribution of not less than 1,500 copies annually of the proceedings." We have then, at our door, a successful solution of the question by a State in which the situation of affairs at the inauguration of the Biological Survey was nearly identical with that in the State of Michigan at the present time. We can hardly do better than to learn of our neighbor and move forward.

To recapitulate: It has been the purpose of this paper to formulate and emphasize the following facts:

1. The responsibility of the State for a scientific study of its own natural resources has become fully established by the continuous practice of our own and many other States.

2. Equally well established in theory, and in various States in practice also, is the fact that a Biological or Natural History Survey is of as great importance and has as great claims upon the State as a Geological Survey.

3. The time is favorable in Michigan for for undertaking a Natural History Survey; and the State Academy is the natural source from which the movement should originate.

4. The Survey should be projected on a broad, liberal and comprehensive plan, but it should include at the outset a specific problem of practical importance and at the same time of scientific interest.

5. Such a problem is presented in the future of the waste lands once covered by the pine forests of Michigan. It is certain before long to attract enough public attention to become a subject of legislation, and our present attitude may do much to determine the course of events in this direction.

6. Meantime there is every reason in favor of proceeding as rapidly as practicable, along lines already suggested, in the development of our State Biological Survey. This, in fact, if not in form, has long been in progress, as the studies of 'Unionidæ in Michigan,' the 'Birds of Michigan,' the 'Michigan Flora' and various other pieces of work of high scientific merit abundantly testify. But it is time now that the work should be organized, that the State should recognize its duty to this form of scientific work, and that we ourselves should be forming clear conceptions of the ecological problems that, in wonderful, if perplexing, interest, are sure to attend, into the twentieth century, the Natural History Survey of Michigan.

V. M. SPALDING.

UNIVERSITY OF MICHIGAN.

A COMPLETE SKELETON OF CORYPHODON RADIANS—NOTES UPON THE LOCOMOTION OF THIS ANIMAL.

THE chief object of the American Museum Expedition of 1896 was to complete materials for the investigation of the evolution of the Amblypoda, and extend our knowledge of *Coryphodon*. Previous observations have been principally upon scattered and imperfect material, and it seemed of the utmost importance to secure materials sufficient to determine the relations of this animal to its ancestral form *Pantolambda*, and to its successive form, *Uintatherium*; also the proportions of the body, the positions of its limbs and the number of its vertebræ. Accordingly the Museum party, led by Dr. Wortman, spent the months of April and May in northwestern New Mexico, revisiting the locality where Cope's most complete *Coryphodon*, *C. elephantopus*, had been found. The search here in the 'Coryphodon' or 'Wasatch Beds' was entirely unsuccessful, but fortunately the underlying 'Torrejon Beds' yielded a remarkably complete series of *Pantolambda*. The party moved to the north in June, and devoted July and August to a most energetic exploration of the Big Horn Basin, especially of the exposures on the south side of the Gray Bull River from Brown's Ranch towards the Big Horn River below Otto.

As a result, parts of 18 individuals were found in the Wasatch Beds (supplementing the 30 individuals found in 1891), and 7 individuals in the Wind River Beds. The selection of portions of nine individuals for mounting was done with great care as follows: The mounted skull, 'American Museum Catalogue,' No 2,867, agrees exactly in size, and is specifically identical with the skull and jaws of No. 5,829. The latter (No. 2,829), while laterally crushed, had associated with it the right scapula and complete forelimb, left scapula and parts of left limb which were used in mounting; also all the vertebræ as far back as the pelvis; these vertebræ, while too much crushed to mount, enabled us to determine the formula and select, from series Nos. 2,865 and 2,863, vertebræ which exhibit the same characters. The latter individual (No. 2,863) included the pelvis and hind limb, thus determining *positively the correct proportions of the entire animal.* The mounting was done with great skill and care by Mr. Hermann.

In general one is struck by the very large size of the head, formidable front teeth, the shortness of the ribs, the heavy character of the girdles, the heavy limbs, and the semiplantigrade or subdigitigrade condition of the feet. It is probable, as already shown

by the writer, that in the hind foot the calcaneum nearly reached the ground in the forward step.

	FEET AND INCHES.	METERS.
Length, incisors to perpendicular of tail	7′ 9½″	2.38
Height at withers	3′ 4″	1.03
Fore limb	2′ 8½″	.82
Hind limb	2′ 11½″	.90

The *skull* presents a very peculiar appearance with its powerful and spreading upper and lower canines, and widely spaced incisors, slender zygomatic arch and broad, flattened cranium.

The rudimentary horn observed for the first time in the parietals is prophetic of the great parietal horn of *Uintatherium*. Many other characters of the skull and skeleton are also prophetic, but there is little tendency displayed to reduce the upper incisors or lower canines into the Uintathere type.*

GENERAL APPEARANCE OF CORYPHODON.

The most accurate forecast of the appearance of the animal was that made by Cope† in 1874 :

"The general appearance of the Coryphodons, as determined by the skeleton, probably resembled the Bears more than any living animals, with the important exception that in their feet they were much like the Elephant. To the general proportions of the Bears must be added a tail of medium length. Whether they were covered with hair or not is, of course, uncertain ; of their nearest living allies, the

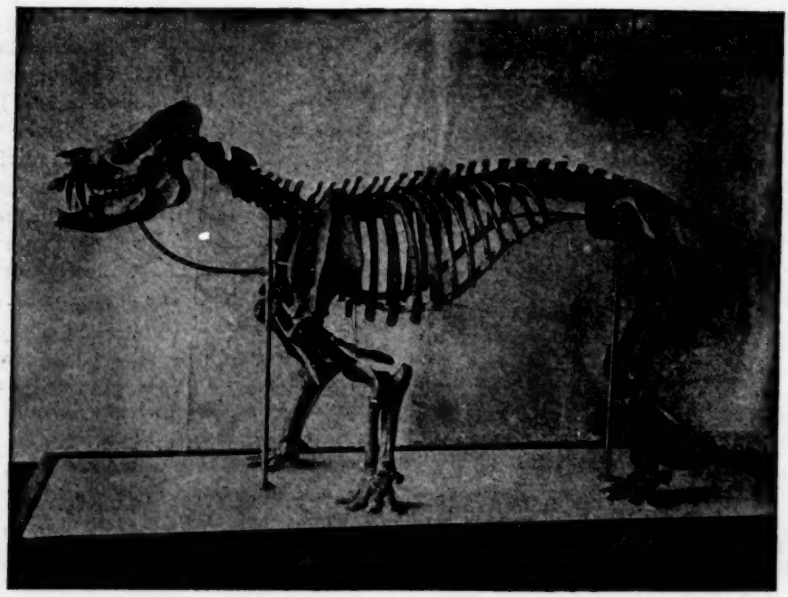

Fig 1.—Mounted Skeleton of *Coryphodon radians*. Slightly exceeding one-fifteenth natural size.

* *Bulletin American Museum of Natural History*, April 4, 1898.

†Vertebrate Paleontology, Vol. IV., Wheeler Survey, p. 203.

Elephants, some were hairy and others naked. The top of the head was doubtless naked posteriorly, and in old animals may have been only covered by a thin epidermis, as in the Crocodiles, thus presenting a rough, impenetrable front to antagonists.

"The movements of the *Coryphodons*, doubtless, resembled those of the Elephant in its shuffling and ambling gait, and may have been even more awkward, from the inflexibility of the ankle. But, in compensation for the probable lack of speed, these animals were most formidably armed with tusks. These weapons, particularly those of the upper jaw, are more robust than those of the Carnivora, and generally more elongate, and attrition preserved rather than diminished their acuteness. The size of the species varied from that of a Tapir to that of an Ox."

Osborn* in 1892 wrote as follows:

"The fact is, the position of the fore and hind feet of *Coryphodon* is absolutely different. The *fore foot was digitigrade*, like that of the Elephant; the *hind foot was plantigrade*, like that of the Bear. In other words, the carpus was entirely raised from the ground and the manus rested upon the distal ends of the metacarpals and upon the spreading phalanges, while the calcaneum and tarsus rested directly on the ground, together with the entire plantar surface of the foot. This substantial difference between the advanced state of evolution of the fore foot and retarded evolution of the hind foot is of great interest. It is clearly shown in the accompanying figures."

In 1893 Marsh,† in his description and restoration, presented quite a different conception of the animal as *unguligrade*. In regard to these matters he made the following statement: "The position first given to the figure is retained in the restoration after a careful investigation of the whole posterior limbs in a number of well-preserved specimens. In *Dinoceras* the terminal phalanges are much larger than in the Elephant, so that they thus bore a greater weight, the digits being undoubtedly free, although a pad may have helped to support the feet. In *Coryphodon* the digits were still more elongate and the terminal phalanges proportionately larger and broader, indicating that they were covered with hoofs that supported the feet. This would agree with the position given them in the restoration, which coincides with the anatomical structure of the entire hind limb."

It appears from our more complete material that the difference between the feet was exaggerated by Osborn, as already observed by Marsh. There is no doubt, however, that, as seen in the mounted specimen, in the forward step the calcaneum rested very near the ground, being separated merely by a thick plantar pad. The digits of the fore and hind feet have nearly the same relations to the ground. *Both feet are in a somewhat similar stage of transition between plantigradism and digitigradism. Pantolambda* has a long tuber-calcis and pes like that of the Bear. *Uintatherium* has a very short tuber-calcis and bore the pes slightly more plantigrade than the elephant. *Coryphodon* has a tuber-calcis intermediate in length; in the astragalus the upper facet for the tibia and lower facet for the navicular presents an oblique angle, the astragalus thinning out to a sharp edge in front (whereas in *Uintatherium* these facets are more nearly parallel, and the astragalus is truncate in front). The angles between the tibial and navicular facets of the astragalus, as shown in sections in Fig. 2, afford the most de-

*Fossil Mammals, of the Wasatch and Wind River Beds, Collection of 1891; Osborn & Wortman, Bull. Am. Mus. Nat. Hist., Sept., 1892, p. 121.

† 'Restoration of Coryphodon,' *Amer. Jour. Science*, Oct., 1893, p, 324.

cisive evidence that the pes of *Coryphodon* was intermediate between the nearly plantigrade *Pantolambda* and the sub-digitigrade *Uintatherium*.

In general *Coryphodon* had a very short back and short, spreading limbs, with a very clumsy, shuffling gait.

HENRY F. OSBORN.

THE MYTH OF THE OZARK ISLE.

THE Ozark uplift, which occupies nearly all of south Missouri and northwestern Arkansas, has long been known as the only noteworthy elevation existing in the whole continental interior plain. Geologically all of this vast region, stretching out from the Appalachians to the Rockies and from the Great Lakes to the Gulf, is made up largely of late Paleozoic or younger rocks, save in one spot, the Ozarks.

As a geographical feature the Ozark uplift is a great, broad dome. Its general surface still preserves the outlines of the great peneplain that existed in the region before the country was affected by mountain-making forces and bowed up. The margins of the elevation are marked approximately by the Missouri river on the north, the Mississippi on the east, the Neosho on the west and the Red river.

The geological structure of the uplift is relatively simple. In the highest or central part are the oldest rocks exposed in the entire Mississippi basin. These are the Algonkian granites and porphyries, the commonly called Archæan nucleus. Surrounding these massive crystallines and occupying nearly all of the central portions of the dome are the Cambrian and Silurian dolomites, the so-called great magnesian limestone series. Farther outward lie successively the Devonian, Lower Carboniferous and Coal Measures. The latter also form the principal surface rocks of the surrounding plain, beyond the margins of the uplift. Thus the great dome presents the oldest rocks in the central and highest parts, and towards the margins and foot younger and younger belts in concentric rings.

This striking and peculiar arrangement of the geological formations around the Ozark dome has long attracted notice, and it has always set forth as one of the direct proofs that the uplift is very old and that the region has remained practically unchanged above sea-level since pre-Cambrian times, forming in the midst of the broad and shallow continental sea a large, ever growing island around which sediments were constantly laid down during all the Paleozoic period. Starting with these premises there have been based recently a number of broad generalizations and rather fantastic hypotheses regarding the deposition and origin of various ores found in the region, the courses of Paleozoic ocean currents, the formation of unusually thick sediments of certain geological age, the distribution of some ancient and peculiar faunas, and even the isolated and independent development of life in the region. These various hypotheses are very attractive in themselves. Based wholly on the assumption of the existence of a large land area in the middle of the continental sea, the colateral evidence used in several of the arguments are strangely corroborative. But going back of the original proposition that has been taken for granted and that has served as the foundation for the several hypotheses advanced, a question naturally arises as to the real grounds for the premises and for the assumed great antiquity of the 'Ozark Isle.'

If there is one thing that modern geography teaches before all else in regard to the existence of an elevated land area, such as is claimed for the Ozark region during all the long span from the pre-Cambrian to the present, it is that it would have been long since worn down to a low-lying plain of faint relief, indistinguishable from the vast

plain around it. But there is a more direct method of finding out whether or not the Ozark uplift really does possess the great age ascribed to it. Marbut, Davis, Griswald and others, who have recently given the region special study from both the geographic and geologic standpoints, all agree in regarding the uplift, as it now stands, as a very modern feature of relief—that is, they assign the age as not earlier than middle or late Tertiary. The proofs that these authors bring forth seem indisputable. Furthermore, there is ample evidence for believing that there were two periods of uprising—one in which the region was bowed up and then reduced to a peneplain, and the other in which the peneplained surface was again uplifted to near its present position. The remnants of the once level plain are still plainly discernible in the existing general surface.

There is another wholly different line of evidence, going to show that during all Paleozoic time no island existed in the present Ozark region, and that the formations later than Cambrian were not laid down in concentric zones around the central crystallines. It is believed that there is ample proof that all Paleozoic formations now represented around the foot of the uplift extended in unbroken sheets over the entire area now elevated, and were not removed until Cretaceous or Tertiary time. Part of the evidence has been published for many years, though it appears to have escaped notice, but much new information bearing directly on this point has been obtained lately. It is essentially this: Far up on the back of the dome—more than three-fourths of the distance from the foot, where the main bodies of the several formations exist, to the central part of the elevation—there are still preserved outliers of Devonian, Lower Carboniferous and Coal Measures. Some of those of the age first mentioned occur very near the summit of the great dome, while those last referred to extend to within 300 feet of the crest. Abundant fossils leave no doubt as to the proper reference to the age of these isolated deposits lying on the older magnesian limestones which constitute the main mass of the dome.

Without going fully into details it must be conceded that the widespread idea of the existence, during Paleozoic times, of a wondrous Ozark Isle, in the midst of a vast continental sea, is a trifle mythical, and it, therefore, must be relegated to the realm of the fanciful.

CHARLES R. KEYES.

NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION—SECOND ANNUAL MEETING, ITHACA, DECEMBER 30-31, 1897.

THE growth of this Association during the past two years has been most encouraging to all friends of science in the State. The Ithaca meeting was marked by a deep interest in the objects of the Association; this was manifest not only in the large attendance, especially of college and normal school professors, but in the earnest discussions at each session, particularly after the Report of the Committee of Nine. The meetings of the American Society of Naturalists and their affiliated societies on Tuesday and Wednesday, and the presence of a number of their members at the meetings of the Teachers' Association, created an atmosphere especially favorable to the objects of the convention. If, perchance, anything could have been lacking to make the environment perfectly auspicious it was supplied by the words and spirit of President Schurman's welcome. He showed himself warmly interested in raising science teaching to the highest efficiency and was ready to recognize thorough preparation in science as a requirement for entrance to college. Throughout all the sessions there was abundant evidence that in accepting

the hospitality of Cornell University the Teachers' Association had found for itself a host of friends. Invitations to go this year to Syracuse and Utica were set aside, and the Council voted to meet with Columbia University and the Teachers College in 1898, following, again, the American Naturalists.

At the first session, Thursday afternoon, Miss Mary E. Dann, of the Girls' High School in Brooklyn, read a paper on 'Physical Laboratory Work in Secondary Schools.' It was evident from this paper and the discussion following it that the sentiment of the Association is unanimous in favor of laboratory work by the pupil in physics, the chief questions being how much? and how? No one questioned the desirability of making some sort of a beginning in schools where such laboratories do not exist.

Dr. E. L. Nichols, the President, lectured in the evening on 'The use of the Lantern in Science Teaching.' He demonstrated the comparative virtues of kerosene, the lime light and electricity, by throwing these three lights side by side on the same screen from three separate lanterns. A number of demonstrations in physics were then projected by the electric lantern.

The evening reception by Dr. Nichols and Mrs. Nichols was a very delightful feature of the meetings.

On Friday morning Professor Cooley, Chairman of the Committee of Nine, read the preliminary report prepared for this meeting. The full text may be obtained from members of the committee. It is printed in the April number of the *Journal of Pedagogy*, Syracuse, together with the papers by Miss Dann and Professor Underwood. The report concludes with three significant theses, which may be summed up as follows:

1. An immediate effort should be made to formulate the objects, lay out plans and surmount the difficulties in the way of a continuous course of nature study in elementary schools. 2. The sciences should be taught in secondary schools by a combination of oral instruction, text-book study and laboratory work; laboratory work should be definitely provided for in the planning of courses, programs and examinations. 3. Science should be accepted as preparation for college when the science has been pursued five hours per week for a year by the method outlined above; when the original records of laboratory work are submitted for inspection by the college, and when all tests of the quality of the work are not less severe than those applied in mathematics and Latin.

These conclusions were well sustained by the speakers of the morning. Lack of suitable preparation on the part of science teachers in the secondary schools was frequently referred to, and it was urged by several speakers that the Association should do something definite in the way of assisting such unprepared teachers in making the right beginning in their science work. This matter and several other propositions dealing with more thorough science work in secondary schools, and the recognition of this work as a requisite for entering college, were referred to the Committee of Nine, to be acted upon before the next annual meeting.

'The Study of Botany in High Schools' was the subject of Professor L. M. Underwood's paper, and of the well sustained discussion following it. Here, again, the importance of trained teachers who can teach lessons from plants as well as from books was repeatedly emphasized, and various means of self improvement were suggested, such as summer schools and special courses in our colleges and universities.

The claims of the American Association for the Advancement of Science were presented by Mr. William Orr, Jr., of the

Springfield, Mass., High School. He urged the science teachers in secondary schools to interest themselves in this national organization, and extended an especial invitation to attend the anniversary meeting next August.

The closing session, Friday afternoon, began with three round tables. The representatives of union schools and academies were led by Principal Thomas B. Lovell, of the Niagara Falls High School, Normal School teachers by Professor Howard Lyon, of Oneonta, and College teachers by Professor B. G. Wilder.

Principal Frederick A. Vogt, of the Central High School in Buffalo, introduced the topic of 'Out-door Science Work in Secondary Schools.' He outlined a number of ways in which the 'laboratory method' may be most profitably employed in the open air, and he contended that many schools, especially in rural districts, are neglecting this most fruitful and convenient means of education and leaning too much on the traditional grind of the school book. The discussion showed that out-door study wherever it has grown to be a feature of science courses is becoming more systematic and rational than formerly. The demand for better work in this line is met by special courses in summer schools and by the preparation of leaflets and guides such as have been issued by the College of Agriculture of Cornell University and many similar institutions.

The following are the officers for 1898:

President, Charles W. Hargitt, Syracuse University.

Vice-President, John F. Woodhull, Teachers College, New York.

Secretary and Treasurer, Franklin W. Barrows, 45 Park Street, Buffalo, of Central High School.

Executive Council:

Professor William Hallock, Columbia University, New York.

Miss Mary E. Dann, Girls' High School, Brooklyn.

Professor D. L. Bardwell, State Normal School, Cortland.

Dr. Charles W. Dodge, University of Rochester.

Principal Thomas B. Lovell, High School, Niagara Falls.

Professor W. C. Peckham, Adelphi College, Brooklyn.

Professor J. McKeen Cattell, Columbia University, New York.

Professor Le Roy C. Cooley, Vassar College, Poughkeepsie.

Professor E. R. Whitney, High School, Binghamton.

Professor Irving P. Bishop, State Normal School, Buffalo.

Mr. Charles N. Cobb, Regents' Office, Albany.

Professor C. S. Prosser, Union University, Schenectady.

A more detailed report of the meeting is published in *The School Journal*, New York, for March 19th and 26th. Dr. Nichols' lecture and Principal Vogt's paper are published in later numbers of the same periodical.

FRANKLIN W. BARROWS,
Secretary.

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*THE NATURAL HISTORY MUSEUM, LONDON.**

THOSE who have visited the Natural History Museum recently and have marked the admirable manner in which the specimens are classified, labelled and arranged in the gallery of mammalia will readily appreciate how valuable an addition to the resources of the student the improvments in the mode of exhibition and the methods of mounting specimens now in progress in the other zoological galleries will afford when the work is complete. As regards the mammals the rearrangement is in a fairly finished state, though of course the process of elimi-

* From the London *Times*.

nating badly-stuffed or worn-out specimens and replacing them as opportunities arise by the best examples of modern taxidermy is one which must ever continue if the Museum is to be maintained as an institution worthy of the nation. As an instance of the difference between the old style and the new, attention may be directed to the fine specimen of a wild lion, shot by Mr. S. L. Hinde, an officer in the service of the British East Africa Protectorate, near Machakos, on August 28, 1897, which is now splendidly set up in a prominent position among the carnivora, having lately taken the place of the old male menagerie specimen, grotesque-looking at the best, presented years ago to the Museum by the well-known showman Van Amburgh.

A feature of the extensive changes at present being made is the gradual disappearance of the polished sycamore stands which for very many years have been in use throughout the zoological department. The light color and reflecting surfaces of these stands not only obtrude themselves on the attention of the visitor, but they do not at all harmonize with the general tone of the specimens. The difficulty has been to find a good substitute. After many experiments of different colors and kinds of surface it has been finally resolved to adopt a suggestion made to Sir William Flower by the late Lord Leighton to use for the majority of the stands a dull surface of a good cigar-brown, produced by staining the wood.

Evidence of reform and reorganization is to be seen in the bird gallery, and here it may be noted that the formal turned perches on which the birds were mounted, and which necessitated a perfect uniformity of position, are being replaced by pieces of natural branches, allowing the taxidermist far greater freedom and variety in mounting the specimens. The new order or classification of the class *Aves* commences on the north side of the gallery, with the struthious birds, or ostrich tribe, including the emus and cossowaries of Australia, the rheas of South America, and the living apteryx and, but recently extinct dinornis, or moa, of New Zealand, and then will proceed through the tinamous, game birds, pigeons, rails, plovers, gulls, petrels, and ducks to the large saloon at the western end of the gallery, where the pelicans and cormorants and some of the birds of prey will be exhibited. On the south side of the gallery will be arranged the remainder of the birds of prey, the owls, parrots, and other picarian birds as well as the perching birds, with which the arrangement will conclude on the left of the main entrance to the gallery. A student, therefore, wishing to examine the higher forms of bird life can, when the work is finished, begin on the left or south side of the room and pursue his studies in regular sequence until he arrives at the ostriches and other flightless birds, or he may commence with the latter and end with the highest forms of passeriformes or perching birds. So far the rearrangement has been completed to the game birds, and many splendid examples of pheasant, partridges and grouse are to be seen. An addition made within the last few days is the group of peafowl, perhaps the most striking and beautiful case in the gallery. It includes examples of the common peafowl, one of the males with the train expanded, a pair of the Burmese peafowl, a hybrid between these species bred in the zoological gardens, and an example of the black-shouldered peacock—a very handsome variety of the common species which has not been met with in a wild state. Among the pigeons which have just been provisionally placed in their case may be seen a fine pair of the now nearly extinct passenger pigeon (*Ectopistes migratorius*). These are remounted examples which have already done nearly fifty years' service, but look as fresh as if they had been shot yesterday.

In the gallery of reptilia an important and valuable acquisition has recently been made in the shape of an unusually large specimen and a skeleton of the Gangetic crocodile or gavial of the Ganges, measuring 16 feet in length. It is thought that no other skeleton of this species is to be seen in any museum or collection in Europe. This powerful and truly formidable looking animal feeds chiefly on fishes, for the capture of which its long and slender snout and sharp teeth are well adapted, but it occasionally devours human bodies.

One of the most beautiful sections of the Museum is the coral gallery, where many decided improvements are noticeable. Thus the sea-anemones in spirit, which do not look very much like sea-anemones in the sea, have had cleverly-executed water-color drawings of living specimens put beside them. The new whale room, for the exhibition of life-sized models and skeletons of whales on a scale never before approached, is making good progress under the director's constant supervision, and will probably be ready for the admission of the public early in the summer.

In the department of geology the recent accessions are many and varied. One which is of special importance and interest is the complete skeleton of *æpyornis*, an extinct wingless bird as large as an ostrich, 5 feet 2 inches in height. The specimen has been reconstructed from the immense series of remains collected in the neighborhood of Sirabé by Dr. C. I. Forsyth Major during his recent expedition to Madagascar. Close to it has been placed for comparison a skeleton of the recent African ostrich.

An interesting specimen presented by Dr. John Murray, of the Challenger, has lately been added to the collection of rocks in the mineral gallery. It is a fragment of gneiss or rock dredged up by the Challenger from diatom ooze at a depth of 1,950 fathoms in the Antarctic Ocean, latitude 53° 55′ S., longitude 108° 35′ E., and is stated to be indicative of Continental land, it having been probably transported by the Antarctic icebergs from land situated towards the South Pole.

Recent additions to the botanical gallery include a table case illustrating parasitic flowering plants. The visitor will note not only the familiar mistletoe, but the more degenerate forms closely resembling fungi in their outward appearance. On the opposite side of the gallery a similar case is nearing completion in which the singular adaptations of flowers to fertilization are exhibited. The models of flowers by Miss Emett are among the most successful this lady has ever made. The exhibition of British fungi is also now nearly complete and the arrival of a new pedestal case is all that is needed to set forth the continuation of Mr. Worthington Smith's beautiful series of drawings. Perhaps the addition which will be first noted by the visitor is the splendid cycad recently presented by Mr. Horace Munn, of Jamaica.

CURRENT NOTES ON ANTHROPOLOGY.

RECENT STUDIES IN MAYA HIEROGLYPHICS.

DR. FORSTEMANN has added another (the 7th) instalment to his series 'On the decipherment of the Maya Manuscripts.' It is devoted to the interpretation of the upper portions of pp. 53–58 and lower portions of pp. 51–58 of the Dresden Codex. They are shown to be occupied with an attempt to obtain a common measure for the apparent years of the planets and the periods of the sun, moon and *tonalamatl*.

The same writer has in *Globus* (Bd. LXXIII., 9 and 10) a very able analysis of the Mayan calendar with reference to the gods governing the days (Die Tagegötter der Mayas). Most of the identifications will be accepted by scholars, though some still remain unknown or dubious.

In the *American Anthropologist* for April

Professor Cyrus Thomas has a critical review of Goodman's book on the 'Maya Inscriptions.' The reviewer points out the incorrect and unscientific character of most of the alleged discoveries, while recognizing that Mr. Goodman has shown for the first time that the periods are indicated on the monuments by symbols instead of by position, as in the codices, and has identified some of these symbols.

THE SCIENCE OF RELIGION.

The first number has appeared of the *Archiv für Religionswissenschaft*, edited by Dr. Thomas Achelis, and published by J. C. B. Mohr, Leipzig (14 Marks). It is a well-printed octavo of 112 pages, containing original articles by Hardy, Roscher, Seler and others, and reviews of recent works. The editor is well and favorably known for his works on ethnology and special studies in comparative religion. The spirit in which the *Archiv* will be conducted is that of broad inductive research and modern philosophical investigation. The problem which will constantly be presented in connection with religious history will be psychological, that is, the critical analysis of religious development as exhibiting the general religious consciousness of the species.

The article by Dr. Seler is on an American subject—the derivation of certain elements in the myths of Central America. That by Roscher is on the significance of Pan in Greek mythology.

It is to be hoped that the *Archiv* will receive adequate support.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

In a recent number of the *Comptes Rendus* A. Leduc has a paper on the composition of air at different places. His figures for the densities of different gases compared with oxygen agree very closely with those of Lord Rayleigh, but compared with air there is a constant difference, which amounts to about 0.0001. From this he draws the conclusion that the air of Paris contains 0.1 per cent. more oxygen than that of London.

The determination of the density of a gas has until recently been considered a difficult operation, requiring not only rather elaborate apparatus but a considerable quantity of the gas to be measured. Professor Ramsay has, however, shown in his work with argon and helium that it is possible to determine the density with accuracy with a quantity as small as thirty cubic centimeters. T. Schloesing, Jr., has now described, in the *Comptes Rendus*, an ingenious method devised by him which is simple, rapid, and accurate within 0.1%, and can be carried out with only a few cubic centimeters of gas. It is based upon balancing in a U-tube two gases, one of which is easily absorbable and whose density is known. After equilibrium is attained, the known gas is absorbed (as carbon dioxid by potash) in order to determine the invisible surface of separation. Very narrow tubes are used to reduce the unavoidable diffusion of the gases, and this has the advantage of reducing the quantity of gas necessary for determination. Hydrogen alone of gases yet examined diffuses too rapidly for the determination of its density. It would seem that this method will prove of great use.

Another paper from the *Comptes Rendus* should be noted in which D. Berthelot describes a new determination of the fusing points of silver and gold. A platinum-iridium thermo-electric cell was used for the purpose, and the melting-point of silver found to be 962° as an average of six experiments, while that of gold is 1064°. These figures are not far from those of Violle: silver 954°, gold 1035°; and the

earlier figures of Becquerel: silver 960°, gold 1092°. Among earlier observations for silver are Guyton de Morveau 1034°, Princep 1000°, Ledebur 960° and Daniell 1223°; for gold, Pictet 1100°, Pouillet 1200° and Wegele 1250°. The variation is not surprising when one considers the meagre means for determination at the hands of the early observer; it is rather surprising that they came so near the truth.

THE *Mitglieder-Verzeichniss* of the Deutsche chemische Gesellschaft for 1898 is just at hand and shows a list of 2989 members, making it the largest chemical society and perhaps the largest scientific society of the world. Its members are by no means confined to Germany, 1268 or over 42% being from other countries, so that it may almost be considered international in its scope. It also indicates the domination of Germany in chemistry. Almost every civilized and some hardly civilized countries are represented in its membership. This country has 285 members and Great Britain 232, these two furnishing over 40% of the membership outside of Germany. Next to these come Austria with 141 members, Switzerland with 131, and Russia with 118.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE WASHINGTON ACADEMY OF SCIENCES.

THE Washington Academy of Sciences adopted on March 29th the following schedule of functions:

1. The holding of meetings to receive the annual addresses of the Presidents of the affiliated societies.

2. The holding of meetings (*a*) to listen to scientific communications from prominent authorities specially invited for the purpose, and (*b*) to hear from selected members of the affiliated societies résumés of recent progress, statements of important questions pending in their respective branches, and other matters of general scientific interest.

3. The publication of proceedings in cooperation with the affiliated societies.

4. The inauguration of measures looking to the provision of a building for the use of the Academy and the affiliated societies.

5. The acquisition of a fund to be used in aid of scientific research.

The Medical Society has been added to the affiliated societies. The list of officers for 1898 is as follows:

President, J. R. Eastman.

Vice-Presidents: From the Anthropological Society, J. W. Powell; from the Biological Society, L. O. Howard; from the Chemical Society, H. N. Stokes; from the Entomological Society, W. H. Ashmead; from the Geographic Society, A. Graham Bell; from the Geological Society, Charles D. Walcott; from the Medical Society, S. C. Busey; from the Philosophical Society, F. H. Bigelow.

Secretary, G. K. Gilbert.

Treasurer, Bernard R. Green.

Managers: Class of 1901—Marcus Baker, Henry S. Pritchett, George M. Sternberg. Class of 1900—F. W. Clarke, C. Hart Merriam, Lester F. Ward. Class of 1899—Frank Baker, Carroll D. Wright.

THE HONORARY WALKER PRIZE.

IN 1864 the late Dr. William Johnson Walker gave to the Boston Society of Natural History a prize fund from which the Council of the Society may, not oftener than once in five years, grant a Grand Honorary Prize. This award may be five hundred or a thousand dollars, at the option of the Council. In previous years this prize has been awarded four times: first, in 1873 to Mr. Alexander Agassiz for his investigations into the embryology, geographical distribution and natural history of the echinoderms; secondly, in 1880 to Professor Joseph Leidy for his prolonged investigations and discoveries in zoology and paleontology; thirdly, in 1884 to Professor James Hall for his contribution to North American paleontology; and fourthly, in 1892 to Professor James Dwight Dana for his distinguished services in natural history.

At the meeting of the Council of the Society held April 20th it was voted to award the Grand Honorary Walker Prize of one thousand dollars to Mr. Samuel Hubbard Scudder, of Cambridge, for his contributions to entomology, recent and fossil. It is surely unnecessary here to dwell upon Mr. Scudder's life-long devotion to science. His contributions to the study of fossil insects of all orders and from all formations, and of the Orthoptera and the Lepidoptera, are

well known; his catalogue of scientific serials and his 'Nomenclatur Zoologicus' are equally well known and invaluable.

All scientific men will agree that in this award the Council of the Society has maintained its past high standard, and will join in wishing Mr. Scudder many years of health and vigor for the continuance of his work.

GENERAL.

THE National Academy of Sciences held its annual stated meeting at Washington last week, beginning on April 19th. A report of the meetwill be published in the next issue of this JOURNAL.

A SPECIAL meeting of the Council of the American Association for the Advancement of Science was held in Washington on April 20th. President Gibbs presided and the Permanent Secretary and President-elect, Professor Putnam, reported on the arrangements for the Boston anniversary meeting. Professor McMahon, of Cornell University, was elected General Secretary in the place of the late Professor Kellicott. A large number of new members were elected, and routine business was transacted. Committees were appointed to consider revisions of the constitution and of the functions of the nominating committee made necessary by the amendments adopted at Detroit.

THE University of Pennsylvania's Marine Biological Institute, on the shores of Ludlam's Bay, at Sea Isle City, N. J., is to be reopened this summer after being closed for five years. Dr. Milton J. Greenman, of the University, will have charge of the laboratory. A large floating house-boat is to be built for the use of students.

THE French government has agreed to recommend an appropriation of 1,500,000 fr. for a building for the Paris Academy of Medicine. The Academy is at present very inadequately installed in the Charity Hospital. The new building will be on the rue Bonaparte.

THE Committee on Science and the Arts of the Franklin Institute has recommended the award of the John Scott Legacy Medal and Premium to Messrs. Blondel and Psaroudaki for their invention of holophane globes. These secure diffusion of the light and an improved distribution so that the light usually sent off above the horizon is deflected downward to points where it is needed. These results are obtained by reflection and refraction, the globes being transparent.

THE Gold Cothenius Medal, of the Leopoldinisch-Carolinische Akademie has been awarded to Professor Emil Fischer, of Berlin.

DR. NANSEN arrived in London from Christiania on April 11th. The visit is in order that he may complete the lectures which he was obliged to postpone last February on account of the illness of his infant son. After a week or so in the country he leaves for Vienna and St. Petersburg.

DR. FREDERIC PETERSON has been elected President of the New York Neurological Society.

WE regret to record the sudden death from pneumonia of D. S. Kellicott, professor of zoology at Ohio State University and at the time of his death General Secretary of the American Association for the Advancement of Science. Professor Ernst Stöckhardt, formerly Director of the Agricultural Institute of Jena, died at Bautzen on March 27th.

THE Philadelphia *Medical Journal* states that the Germans have been slower than others in adopting the Bertillon system of personal recognition by a series of measurements and the notation and registration of any natural pigmentary or hairy peculiarities. While the system is in use in France and very generally in Belgium, Switzerland, Russia and Italy, only isolated cities in Germany have adopted it. Some recent work with it at the prison at Moabit, in Berlin, has been encouraging, and now it is announced that the police departments of most of the South German towns are about to adopt it, Munich, Nürnberg, Regensburg, Augsburg and Würzburg having already made the necessary arrangements for its introduction.

IT is against the etiquette of the medical profession to secure patents on medical discoveries and in Germany men of science hesitate to patronize the patent office. There does not appear to be such a decided objection to patents among British and American men of science. Lord Kelvin has, according to a paper read by

Dr. Magnus Maclean before the Philosophical Society of Glasgow, taken out 47 patents between the years 1858 and 1896. Of these patents 11 are for improvements in electric telegraphic apparatus, 24 for improvements in the control of electric currents, 10 for improvements in instruments of navigation and two for valves for fluids.

THE American Microscopical Association will hold its next annual meeting at Syracuse, N. Y., from the 30th of August to the first of September.

THE American Neurological Association will hold its twenty-fourth annual meeting in New York at the New York Academy of Medicine, on May 26th, 27th and 28th.

GOVERNOR BLACK has signed the bill authorizing The American Museum of Natural History, New York, to purchase and lease property.

THE appropriation of $25,000 made in recent years by the Legislature of the State of New York for the extension of agricultural teaching, under the auspices of Cornell University, has this year been increased to $35,000.

A DECREE has been published forbidding the importation into Austria of American fresh fruit, plants, fruit wrappers and fruit packings, etc., in cases where the examination at the port of entry results in the discovery of traces of the San José scale.

A NEW museum was opened at Keswick, England, on April 11th, being erected in memory of Thomas and Henry Hewitson, the donors of the Fitz Park. In an opening address Professor G. A. Smith, of Glasgow, spoke of the educational value of museums, and contrasted 'the keenness of America in this matter with the apparent backwardness of Great Britain.' We fear the compliment to America is scarcely deserved.

IN connection with the Trans-Mississippi Exposition in Omaha this summer, there is to be an Educational Convention on June 28th–30th. One of the features of this convention will be the Conference of Science Teachers. Arrangements have been made for papers on various sciences and elements in the curricula of the high schools, colleges and universities as follows: Astronomy—Professor Howe, University of Denver; Botany—Professor MacMillan, University of Minnesota; Chemistry—Professor Palmer, University of Colorado; Geography—Professor Haworth, University of Kansas; Physics—Professor Nipher, Washington University; Zoology—Professor Ward, University of Nebraska. Geology is still to be provided for. It is hoped to bring together a considerable number of Western teachers of science in this conference.

THE National Education Association meets at Washington on the 5th to the 12th of July. There is a Natural Science Section, of which Professor P. C. Freer, of the University of Michigan, is President, and Mr. C. J. Ling, of Denver, Colorado, is Secretary. On July 8th Professor Freer will make an address on 'The Relation of Natural Science Instruction in the High School to that in the University.' A standing committee, of which Mr. A. Smith, Chicago, is Chairman, will report on biological work in the high schools, and the training of teachers for work in science in the secondary schools will be discussed.

ACCORDING to the London *Times*, English interests were well represented at the recent International Congress on Commercial Education at Antwerp. The official delegates from Great Britain included Mr. T. King, Senior Chief Inspector of Schools, and Mr. R. L. Morant, representing the Education Department; Captain W. de W. Abney, C.B., F.R.S., and Mr. Gilbert R. Redgrave, representing the Science and Art Department; Mr. Woodall, M.P., and Mr. Swire Smith, members of the Royal Commission on Technical Instruction, and Mr. John Brigg, M.P., representing the County Council of the West Riding of Yorkshire. The London Chamber of Commerce was represented by Sir Albert Rollit, M.P., Mr. Frank Debenham and Mr. Montagu Barlow. The technical committee of the London County Council had also its representative, as likewise several of the provincial county councils. Some of the grammar schools, Bradford for instance, keenly alive to the value of attentively watching the debates, sent delegates to Antwerp. The Congress marked the 25th anniversary of

the foundation of the Students' Association fo the Institute, and the new school buildings were utilized for the proceedings. Among the papers discussed was one by Mr. E. E. Whitfield, of Galashiels, on 'Commercial Education in Great Britain.' The questions brought forward comprised the entire range of commercial education.

THE Section of Astronomy of the Paris Academy of Sciences has recommended the publication by the Academy of Pingré's 'History of Astronomy in the 17th Century.' This work has had a curious history. At the recommendation of Lagrange the Academy decided to publish it in 1791, and made an appropriation for this purpose. But owing to the death of Pingré and to the French Revolution the printing was suspended after some sheets had been prepared. Both these sheets and the balance of the manuscript have been lost for a hundred years, but now M. Bigourdan has discovered a single copy of the sheets in the hands of a French collector and the balance of the manuscript in the archives of the Paris Observatory, lost among observations of Tycho's. The work is said to be not only of historical interest, but also of value to contemporary astronomy in view of the careful observations that it records.

A VERY important contribution to the anthropology of European populations is promised for publication in the forthcoming *Comptes Rendus* of the Association française pour l'Avancement des Sciences. Dr. J. Deniker, librarian of the Musée d' Histoire Naturelle at Paris, will publish, with full bibliographic data, a large and detailed map of the cephalic index of Europe. This is based not only upon an exhaustive collection of published material, but upon much new data from Portugal, the Balkan States and other out-of-the-way regions, of which little has heretofore been known. This valuable work is to be followed by similar treatment of the stature and pigmentation as well, large maps in color having already been constructed for each characteristic.

DR. DANIEL G. BRINTON, of the University of Pennsylvania, read a paper entitled 'Before the Dawn—Literature Among Savage Tribes' before the members of the Comparative Literature Society, in Carnegie Lyceum, on April 9th. 'Thunder Cloud,' an Indian of pure American descent, elucidated Dr. Brinton's remarks by chants and recitatives in several Indian dialects.

THE Cartwright Lectures of the College of Physicians and Surgeons, Columbia University, will be given at the Academy of Medicine, New York, on Tuesdays, April 26th, May 3d and 10th, at 8:15 p. m., by W. W. Keen, M.D., professor of the principles of surgery and of clinical surgery in Jefferson Medical College. His subject will be, 'The Surgery of the Stomach.'

ON account of the frequent requests received at the Yerkes Observatory for lantern slides and prints from astronomical photographs, it has been thought advisable to make provision for supplying them. Mr. G. Willis Ritchey, Optician of the Observatory, who has had wide experience in making and copying astronomical negatives, has undertaken to furnish such photographs at moderate expense. He is prepared to supply lantern slides, transparencies and paper prints from any of the negatives in the collection of the Yerkes Observatory. Among the subjects available at the present time may be mentioned: Professor Hale's photographs of prominences, faculæ and other solar phenomena, and of stellar spectra; Professor Barnard's portrait-lens photographs of the Milky Way, nebulæ, comets and meteors; Professor Burnham's photographs of the Moon, Winter and Summer views of Mt. Hamilton and the Lick Observatory; Mr. Ellerman's photographs of the buildings and instruments of the Yerkes Observatory; and Mr. Ritchey's Kenwood Observatory photographs of the Moon. A more complete list of subjects may be had on appliion to G. Willis Ritchey, Yerkes Observatory, Williams Bay, Wisconsin, to whom all orders should be addressed.

THE Vienna correspondent of the London *Times* telegraphs that some interesting particulars of a new application of the Röntgen rays for curative purposes were communicated by Dr. Edward Schiff, lecturer at the Vienna University, at the last sitting of the Imperial and Royal Medical Society. A series of experiments conducted by Dr. Schiff and his assistant proved

that these rays could be used for the cure of disease in a manner capable of perfect control by means of a more or less intense application for a longer or shorter period, producing reaction in the exact degree required. In this way it has been possible for the lecturer, on the one hand, to remove hair from parts of the body where it constituted a disfigurement without causing the slightest inflammation, while, on the other hand, he has been able to treat lupus with uniform success by means of an artificial inflammation, the intensity of which he was in a position to increase or reduce at will. The results secured by the new method both in the removal of superfluous hair and the treatment of lupus were demonstrated in the persons of some of Dr. Schiff's patients.

AT the annual meeting of the Michigan Board of Health on April 8th the President, Mr. Frank Wells, made an address, the greater part of which related to the outbreaks of typhoid fever along the St. Clair and Detroit rivers, at Port Huron, St. Clair, Marine City, Detroit and Wyandotte, especially the recent one at the city of St. Clair. He was emphatic in his belief that the Board should enter upon a more thorough investigation of the waters of St. Clair river, with a view to ascertaining, if possible, where, when, under what circumstances, and how the river is contaminated, whether the contamination is intermittent or constant, what is the result of dredging the sewage sludge out of Black river at Port Huron, and whether the contaminations which constantly enter the river at Port Huron find their way into the water supplies of the cities along the river, and under what circumstances such contaminating material finds its way into the water supply of Detroit. The questions are of vital importance to the citizens residing along the St. Clair and Detroit rivers, and such investigations would be of inestimable value. The President said he knew that the funds at the disposal of the State Board were inadequate, but he hoped that the Board would see its way clear to pushing the investigation at least far enough to learn the importance of such work, when if it proves to be as important as he thought, the Legislature would undoubtedly do as they have in other States, make provision for having the investigation properly made. The Secretary of the Board mentioned that he had had several samples of water from the river examined, from the river as it leaves Port Huron, from the river opposite the intake at St. Clair, from the water works in St. Clair, from a tap in St. Clair, and from the river as it leaves St. Clair. All of the samples were found to be contaminated.

THE following note from our literary contemporary, *The Critic*, may prove of interest to men of science: "One might enjoy the humor injected into the situation at the Castle Garden Aquarium, if it were not such a direct menace to the best interests of that admirable institution. If Col. James E. Jones has said all the things attributed to him by the papers, and there is no reason for doubting that he has, he should be keeping a fish-stand in Washington Market, rather than managing an aquarium that is designed to be of scientific benefit to the public. His predecessor, Dr. Bean, knew his business, and managed the interests of the Aquarium as it was intended they should be managed. He was not a Tammany man in politics nor in his methods. Hungry Tammanyites were after the office, however. Mr. Croker is said to have hinted to Dr. Bean that his salary was wanted for another man, but he refused to take the hint. Tammany has an excellent plan for securing any salary that it wants for its own people, when it cannot oust the person who is drawing it. The office is abolished—and afterwards re-created. The Tammany man is then put into the newly-created office, and all goes well—that is, as far as he is concerned; but it goes very ill for the public. Most of us thought that Dr. Bean was the right man in the right place, but we are told by his successor that he was 'too damn scientific to run an Aquarium.' That was a new view of the situation. Col. Jones has expressed other views quite as new and startling. He may know a hawk from a hern-shaw, but he tells us quite frankly that he does not know much. He said to a *Times* reporter:

"Take those specimens of sea anemones, for instance. They're out there in the laboratory, and few know anything about them, and more care less. What

are they, a fish or a vegetable? I'm darned if I know, and I guess there are a whole lot like me.

"Col. Jones also confesses to being a 'jollier,' but adds that he will curb his 'jollying' habit for a time at least, and attend to business. His favorites in the Aquarium are the seals, because they are 'just too funny for anything,' particularly one who 'squirts water over people.' Are they, I should like to know, any funnier than Col. Jones? He has said enough to cause his instant dismissal by any other government than one that made its way into power with the battle-cry, 'To Hell with reform.'"

A SCIENTIFIC expedition under the direction of Dr. Nordenskiöld has been organized in Sweden to explore the Klondike region. The expedition, the expenses of which will be defrayed by Mr. Elk, director of a large banking house in Stockholm, was expected to leave Sweden on March 23d. Dr. Gunnar Andersson, docent in geology in the high school at Stockholm, will accompany the party, which is expected to be absent about two years.

THE Government Statist of Victoria estimates the population of the Australasian colonies at the end of 1897 at 4,410,124. When the census of 1891 was taken the numbers were 3,809,895, so that there has been an increase since then of 15.75 per cent. The population of Victoria is estimated at 1,176,238, an increase of 35,833. The births exceeded the deaths during the period by 127,418, but the loss by emigration 91,000. The increase per cent. in Victoria was 3.14; in New South Wales, 16.89; in south Australia, 13.29, and in Western Australia, 225.23.

THE Council of the Imperial Institute have authorized the holding of an exhibition of acetylene-gas apparatus in the grounds of the Institute at an early date, and, in order to ensure that no apparatus should be admitted to the exhibition unless it was shown to fulfil the requisite conditions of safety, the Council of the Society of Arts have appointed a committee to decide upon those conditions and to lay down rules for the admission of apparatus. The following gentlemen have been appointed to act on this committee: Major-General Sir Owen Tudor Burne (Chairman of the Council), Sir Frederick Bramwell, Professor James Dewar, Mr. Harry Jones, M. Inst. C. E., Professor Vivian B. Lewes, Professor Boverton Redwood, Professor W. C. Roberts-Austen, Professor J. M. Thomson and Sir Henry Trueman Wood (Secretary). Full particulars will shortly be issued as to the regulation and rules laid down.

A FEW weeks hence, says the London *Times*, work will be begun upon an important new building in the neighborhood of Dulwich—the Horniman Free Museum, which its founder, Mr. Frederick J. Horniman, M. P., intends to present as a free gift to the inhabitants of that neighborhood. The new building will consist of two galleries, each upwards of 100 feet long, lighted from the top. In addition, there will be a large lecture-hall having a seating capacity for 300 persons. Altogether, the museum, including the administrative block, will be some 300 feet in length, and will present a very handsome appearance, its front being constructed entirely in stone, with a clock tower of striking design, over 100 feet in height. The galleries will be divided into various courts, each devoted to a separate class of the interesting objects of which the museum proper consists. Thus there will be a pre-historic court, an Egyptian court, an Indian court, a colonial court, a Japanese court, and so-forth, while there will be special departments for the zoological and entomological specimens as well as for the large library. During the last 35 years Mr. Horniman has been acquiring the freeholds of the various properties adjacent to the house in which, for seven years, his collection has been on public view. The 15 acres so acquired he intends to convert into a public park and recreation ground, while Surrey Mount, an existing mansion therein—from which is to be obtained one of the finest views in the district—is to be fitted up as a free library and club house, separate rooms being devoted to the free use of the scientific and other clubs in the vicinity. The new museum, of which Mr. C. Harrison Townsend is the architect, will be within three or four minutes' walk of Lordship-lane and Forest-hill railway stations, and will thus be in the center of a rapidly extending neighborhood.

Since Mr. Horniman's collection was opened to the public, seven years ago, more than 455,000 people have visited it in its temporary home.

AT a meeting of the Trades League of Philadelphia on April 14th the following resolutions were adopted:

WHEREAS, There is at the present time no general system of sanitation and disinfection throughout the United States, guided and controlled by one general head and working in harmony with local and State Boards of Health; and

WHEREAS, The presence of an epidemic of contagious diseases in any part of the country without such general system of control breeds fear and panic, from a lack of confidence in the ability of the local Board of Health to control the epidemic within a contracted radius of territory; and

WHEREAS, Localities within hundreds of miles of the infected district quarantine against it and other places near it, thus resulting in enormous losses to commercial and transportation interests of the country at large; therefore, be it

Resolved, That the Trades League of Philadelphia, an organization of nearly two thousand business firms, earnestly recommend the establishment, by the National Government, of a commission of public health, to be known as the 'National Commission of Public Health,' which shall be a bureau in the Treasury Department, and the duties of which shall be to collect and disseminate information with regard to the prevalence of infectious diseases in this and other countries, to collect and publish vital statistics, to prepare rules and regulations for securing the best sanitary conditions of vessels from foreign ports and for preventing the introduction of infectious diseases into the United States and their spread from one State or Territory or the District of Columbia, and, in general, to make investigations, publish information and formulate rules with a view to the preservation of the public health.

Resolved, That the Legislative Committee of the Trades League shall give the subject their careful and prompt attention, with 'power to act' as the importance of the subject may demand.

IN a recent lecture at the Royal Institution, London, on some analytical uses of liquid air, Professor Dewar stated, according to the account in the London *Times*, that low-temperature work has been greatly extended of late, and that both on the Continent and in America there had been a large development in the applications—or projected applications—of liquid air. He proceeded to explain the use of this agent for the qualitative separation of the gases composing a mixture, and practically illustrated the method with a sample of the gas given off by the Bath springs, which was thus shown to contain argon, helium and a hydro-carbon that was liquid at ordinary temperatures. Referring to the cessation of chemical action with extreme cold, he said that photographic effects alone persisted, but had lost some 80 per cent. of their intensity. It was a curious fact that the photographic activity of ultra-violet light, though the greatest at ordinary temperatures, suffered most diminution at low ones. In conclusion the lecturer spoke of the thermal phenomena presented by the vacuum jacketed vessels, of which he introduced the employment. Pictet after an elaborate investigation concluded that below a certain temperature all substances had practically the same thermal transparency, and that a non-conducting body became as ineffective as a conducting one in shielding the vessel from heat. But Professor Dewar's experiments showed that such was not the case, the transference of heat observed by Pictet appearing to be due not so much to the materials themselves as to the air contained in their interstices. By filling the annular space between the walls of several similar vacuum vessels with various substances and exhausting them all equally of air, he found large differences in the thermal transparency of the substances, as measured by the rate of evaporation of liquid air contained in the tubes. Moreover, the thermal transparency of some materials diminished at very low temperatures instead of increasing, as had been asserted to be the case. Thus, of two vacuum tubes, one simple, the other having powdered carbon in the vacuous space, the latter at low temperature was the more efficient preserver of a liquid air, showing that the carbon diminished the radiation. But when the vacuum was destroyed and warm air admitted into the space, the liquid in the carbon tube boiled off much more vigorously than that in the simple tube, indicating that at an ordinary temperature carbon allowed more heat to pass than did air.

ONE of Dr. Linde's machines for the liquefaction of air, says the London *Times*, has been

exhibited at work in the rooms of the Society of Arts. Its action is based on the fact that air, not being a 'perfect gas,' is reduced in temperature when suddenly allowed to expand through a narrow orifice from a high to a low pressure. The slight cooling effect thus obtained is rendered cumulative by the cooled air being used to abstract heat from the air that has not yet passed the orifice. Each successive portion of air is, therefore, cooler when it reaches the orifice than was its predecessor, and thus in time so low a temperature is reached, provided due precautions are taken to insure thermal isolation, that a change of state occurs and air appears in the form of liquid. The particular machine on view circulates each hour about 15 cubic mètres of air, which is expanded from a pressure of 200 atmospheres to one of 16, and produces about 1.9 litres of liquid air an hour with a continuous expenditure of three-horse power. Although the oxygen and nitrogen of the atmosphere liquefy simultaneously, still the latter evaporates more quickly, and this fact can be utilized to obtain a liquid which is very rich in oxygen. An interesting application of liquid air containing 40 or 50 per cent. of oxygen has recently been made. Mixed with powdered charcoal it forms an explosive which is comparable in power to dynamite, and which, like dynamite, can be made to go off violently by using a detonator. Trials which have been carried out with this material in a coal mine at Penzburg, near Munich, are claimed to have given very satisfactory results. The explosive is cheap, its cost being practically that of liquefying air; but, of course, owing to evaporation, it is only capable of exploding for a few minutes after being mixed.

UNIVERSITY AND EDUCATIONAL NEWS.

President Dwight, of Yale University, has published his annual report. He suggests suitable gifts to the University amounting in value to over $3,000,000, which he hopes may be secured in celebration of the coming bi-centennial. The value of the Lampson bequest is stated to be upwards of $400,000. President Dwight especially dwells on the need of a building for the work in physiological chemistry, the need of $150,000, which, with the existing fund of $100,000, will make possible the completion of the Peabody Museum and the desirability of enlarging the observatory. The library acquired by purchase during the year 7,840 volumes and by gift 1,385 volumes, and the pamphlets added to the library were 6,300 in number. During the past ten years the teaching force of the University has increased from 43 to 102.

The Board of Overseers of Harvard College have adopted the following resolution:

Resolved, That the overseers will see with pleasure the admission requirements of the Lawrence Scientific School brought as rapidly as circumstance may permit to substantial equality with those of Harvard College, provided that, in so doing, the standard for admission to the Scientific School shall be steadily raised, and that for admission to the College in nowise lowered.

The New York State Department of Public Instruction has decided to hold four summer schools this year for the teachers of the State. The past two years two schools have been held, at Chautauqua and Thousand Islands Park. The two additional schools will be held at Greenport, Long Island, and Ithaca.

The West Virginia University has established eleven fellowships yielding $300 yearly and free tuition. The fellows are expected to teach one hour a week or give two hours' supervision in the laboratory. In the eleven subjects for which the fellowships are awarded, the sciences are well represented, they being as follows: Chemistry, Physics, Geology, Zoology, Botany, Mathematics, Mechanical Engineering, Civil Engineering, Economics, English and Greek.

The estate of Mrs. Julia W. James, of Boston, divided by her will between the Museum of Fine Arts and the Massachusetts Institute of Technology amounts to over $500,000.

At Harvard University Mr. S. I. Bailey has been promoted to an associate professorship of astronomy and Dr. W. T. Porter to an associate professorship of physiology.

Dr. Norman Wilde, assistant in philosophy in Columbia University, has been appointed instructor in philosophy in the University of Minnesota.

The John Tyndall Fellowship of Columbia

University for the encouragement of research in physics has been awarded to R. B. Owen, a graduate of the School of Engineering and professor of engineering in the University of Nebraska. Of the twenty-four fellowships annually awarded, the following fall more immediately within the field covered by this JOURNAL: T. E. Hazen, botany; B. H. Owen, philosophy; J. D. Irving, geology; E. Kasner, mathematics; W. C. Kretz, astronomy; J. W. Miller, Jr., mechanics; F. C. Paulmier, zoology; F. J. Pope, chemistry; C. E. Prevey, statistics; R. S. Woodworth, psychology.

HERR KRUPP has given 20,000 M. to the Institute of Physical Chemistry at Göttingen.

A COMMISSION of ten members of the Paris Municipal Council has been appointed to study the relations between the city and the University.

SOMETIME since we called attention to the decree excluding foreigners from the engineering departments of the Berlin School of Technology. The *Scientific American* quotes some German opinions of the subject. Thus the *Deutsche Zeitung* remarks: "At the non-Prussian high schools at Munich, Dresden, Stuttgart, Carlsruhe, Darmstadt and Brunswick there are 1,200 foreigners out of 8,682 students. We hope that, as the foreigners use their knowledge to the detriment of German industry, the non-Prussian governments will forthwith exclude them." It is learned that for some time past there has been an exchange of views between Prussia and the other German governments on this subject, and there is no telling how soon the policy may become general throughout Germany. The following expression by a high German official indicates the feeling on the subject: "There is no question that the German technological schools and industrial and scientific institutions will soon be forced to adopt a less liberal policy with foreigners. The tricks of trade we have been teaching them so long are now being used against us to the great injury of our industry."

DISCUSSION AND CORRESPONDENCE.

COLOR VISION.

IN a paper upon Color Vision, published in SCIENCE, April 15, 1898, Professor W. Le Conte Stevens deplores the unsettled state of psychological opinion on matters of visual theory. "The bewildered physicist * * * * despairingly beseeches the psychologists to agree among themselves, but they will not agree; on the contrary, the prospect seems to be that additional color hypotheses will continue to appear until from their abundance they cease to receive attention." In the present article I hope to be able to show that the psychology of Color Vision is not quite so chaotic as to Professor Stevens it seems to be.

First of all, however, I desire to express my appreciation of the courtesy and frankness with which the author's challenge to the psychologists is made. The work of scientific men to-day is very highly specialized, and it taxes one's energies to the utmost to keep abreast of the movement of thought in one's own special province. Nevertheless, we are all, to some extent and in certain cases, dependent upon our neighbors; we must at times make excursions into adjacent scientific fields. Here, then, is a great difficulty. If we stay at home we fail of knowing something that we ought to know; if we travel into another domain we are apt to go astray. We have no perspective in the unfamiliar science; we cannot distinguish the important from the unimportant; our reading of the literature has been intermittent and perfunctory. However earnest our attempt to find out what is doing next door, its result must oftentimes be a personal bewilderment and confusion, which we may very easily make objective and ascribe to what is in reality a perfectly orderly household. I have sometimes left the study of a disputed point in nerve physiology with the feeling that the whole issue was a matter of the merest conjecture; but a subsequent talk with a working neurologist has given me a scale of values, and indicated definitely enough to which side the balance of probability inclined.

Professor Stevens, writing as a physicist, gives up the psychological problem of Color Vision, and calls upon the psychologists to settle the question for him. We cannot quite do that, because Color Vision is, and will for some time remain, debatable ground. But we can, returning his candid appeal an equally candid answer, give him the clue to the maze of hypothesis, or,

to take up the former metaphor again, show him the competing theories in their right perspective.

It may be said, without any hesitation, that there are now only two discussable theories of Color Vision, those of Helmholtz and of Hering. The theories of König, von Kries and Mrs. Ladd Franklin are simply improvements on (or modifications of) the 'tri-component' theory of Helmholtz. The theories of G. E. Müller and of Ebbinghaus stand in a like relation to the 'antagonistic color' theory of Hering. I will say a few words upon both theories.

I. The Helmholtz theory.—This theory was devised to explain 'the phenomena of color mixture and color analysis' (Stevens, p. 520). It does explain them, admirably; it explains nothing else. It breaks down in face of the facts of color blindness, of indirect vision, of after-images and contrast, of the Purkinje phenomenon, etc. Hence, its original and most attractive simplicity (p. 516) has been given up in favor of König's shift of excitability in the three elementary substances, von Kries' double white-process (one-fibre white and three-fibre white), and Mrs. Ladd Franklin's hypothetical molecule of suicidal tendency. All these modifications are of the nature of subsidiary or 'bolstering' hypotheses; each of them has had grave experimental objection urged against it.

II. The Hering theory.—"The Hering hypothesis," says Professor Stevens, "is well known and probably universally rejected among physicists." The latter part of this statement I believe to be substantially true; the first half I must take leave to doubt. Hering's theory in its modern form has nowhere received complete exposition. Indeed, if Professor Stevens has not, in the course of his psychological reading, come upon Ebbinghaus' theory, which is readily accessible in a recent volume of the *Zeitschrift für Psychologie*, the conclusion is almost forced upon one that he has not himself followed up the Hering theory in its meanderings through a large number of scattered journals, some of which are now not at all easy to procure. A brief account of my own experience may, perhaps, serve to justify the bluntness of this remark. Until recently there was one weak point in the Hering theory which absolutely forbade its acceptance by the psychologist. Having satisfied myself that this defect was really fatal to the theory, I was content for several years to know only the general accounts of it given, *e. g.*, in Helmholtz's *Optik*, Wundt's *Physiologische Psychologie*, Hermann's *Handbuch*, Hering's own *Zur Lehre vom Lichtsinn*, etc. Not till the publication of Müller's article, which removed the difficulty, did I make any serious effort to gain a thorough understanding of Hering's point of view. And if the psychologist is thus remiss, what can be expected of the physicist?

Hering's theory is, in actual fact, every whit as adequate to the phenomena of color mixture as is that of Helmholtz. It also offers a self-consistent explanation of the other phenomena referred to above. It has, further, on more than one occasion, been led to predict a certain state of sensitivity or sensible discrimination, and its predictions have been verified. I do not know what more can be demanded of a psychological theory. The objection to it was that the concept of antagonism was used in one sense for red-green and blue-yellow, and in another, quite different sense, for black-white; but Müller has demonstrated that the black-white antithesis may be of precisely the same nature as the other two, despite the existence of the sensation gray. Ebbinghaus' theory (which is, by the way, a model of expository method) attempts to find an anatomical substrate for the three visual substances of the 'antagonistic color' theory.

I have so far said nothing of Wundt's theory. This, the periodicity theory, did not, of course, originate in the *Philosophische Studien* article to which Professor Stevens refers; it antedates Hering's *Zur Lehre*, etc. (see *Phys. Psych.*, 1874, p. 388; 1880, p. 452). It arose by way of reaction against Helmholtz, and has the merit of possessing an independent white-process. But, though it covers all the facts, it covers them too loosely to serve as a genuine working hypothesis. Hence it has never succeeded in getting itself discussed. It was an excellent makeshift so long as definite factual objections could be urged against Helmholtz and Hering

alike; it loses its value as soon as we have a more explicit theory which leaves no important fact of psychological optics outstanding. I cannot at all assent to Professor Stevens' assertion that the theory 'has a good following among psychologists.'

M. Nicati's theory is contained in a single forty-page article, which has not as yet received the compliment of an abstract in the *Zeitschrift*, or the *Année psychologique*. M. Nicati and Professor Patten have, as Professor Stevens says (p. 515), a perfect right to the enunciation of their hypotheses if they believe that these add to the intelligibility of the observed facts. But the hypotheses must be worked out in fiftyfold greater detail, and set upon a fiftyfold wider basis of observation and experiment, before they cease to be the private property of their authors and command general attention. The psychologist must know them in the sense that he must know his literature at large. He is no more disturbed by them, however, than is the biologist by the thousand and one theories of heredity and transmission that have been formulated since the days of pangenesis.*

In conclusion, I must ask Professor Stevens and other readers to excuse the dogmatic tone of this communication and to attribute it to limitations of space. References could be given for every statement. I may add that my own conversion to the Hering theory has been exceedingly gradual, the result of a systematic working through of argument and counter-argument, under experimental control; and that, so far as I am aware, I have absolutely no bias in favor of any theory. There are three or four other theories of vision, not mentioned in these two papers, which I should rate higher than either that of M. Nicati or that of Professor Patten. Psychologists should be grateful to Professor Stevens, not only for raising a general question which concerns both physics and psychology, but for his 'physical' criticisms upon the Helmholtz theory.

E. B. TITCHENER.

*M. Nicati's hypothesis posits a primary gray-vision, and proceeds with a tri-component color theory on an electrical-physiological basis. It is apparently a remote offshoot of the Helmholtz theory.

THE DEBT OF THE WORLD TO PURE SCIENCE.

TO THE EDITOR OF SCIENCE: Professor Stevenson's admirable address, recently published in SCIENCE, calls to mind the sometimes forgotten fact that there are still those who in considering the labors of science, scornfully ask: "What is the use of all this?" Of all forms of scientific propagandism the exhibition of specimens in a scientific museum might seem least likely to bear fruit to financial profit. That even here, however, the practical benefits of science can be demonstrated, the following examples that have recently come under my observation may be cited. They are of no great consequence themselves, but illustrate a principle which undoubtedly has wide application and, coming to my notice quite by chance, are probably typical of hundreds of similar instances which occur.

A government contract was to be let for the building of a breakwater. The filling was required to be rock of a certain toughness and durability. The local contractors, with a unanimity born either of accident or design, declared that it would be necessary to go more than a hundred miles to obtain such rock and a railroad would have to be built to transport it. Their estimates of the cost of the work were made accordingly. There was not time for contractors at a distance to explore the region, but one contractor, living two thousand miles away, sent a prospector about in the vicinity of the proposed work, with instructions to forward him samples of such rock as might be suitable for the work, with information as to the quantity of each in sight. These samples the contractor brought to a museum, and by comparison with the specimens there, and consultation with the Curator, learned that one of the rocks collected possessed the required qualities. He also learned that the quantity was probably assured by the fact that it was an eruptive rock of which more could be obtained by deeper quarrying. Relying on this information, he made a bid on the work at a price $75,000 lower than any of the other contractors had done. The information he had gained may be credited with having saved the government that amount.

A company endeavoring to sell stock in a

Western mine distributed, as one of the products of their 'Holy Terror,' specimens which they denominated metallic cobalt. The substance looked metallic enough, and local assayers being unable to deny their statement the shares found ready sale for a while. But after a time one doubting Thomas brought his specimen to a museum to see if by comparison with anything there he could establish its cobaltic character. A little comparison showed him that his specimen was carborundum, and carborundum he learned was not made by the reduction of cobalt ore. Whether he imparted this information to others who thought of purchasing shares I do not know, but it is likely that the output of carborundum from cobalt (?) mines received a serious set-back after his discovery.

A Canadian prospector working in a little-explored region found a deposit which for some reason he believed to be zinc ore. He was so well convinced of this that he made his way to a large city for the purpose of obtaining means to work the ore. Visiting a museum where specimens of zinc ore were exhibited, he compared them with his own and at first concluded that the two were identical. On looking further, however, he saw specimens of septaria, which he at once recognized as representing his own specimens. His dreams of a zinc mine were dissipated, but that the awakening had come before he had expended his own and other's means was due to his improving an opportunity to consult an accurately classified and identified, in other words, a scientific collection.

Oliver C. Farrington.
Field Columbian Museum.

SCIENTIFIC LITERATURE.

Darwin, and After Darwin. III. Post-Darwinian Questions, Isolation and Physiological Selection. By the late G. J. Romanes. Chicago, Open Court Pub. Co. 1897.

The writings of the late Dr. Romanes are always interesting, whether one agrees with his conclusions or not. The present volume deserves to be widely read by naturalists, not only as a clear exposition of its author's views on evolution, but as an admirable stimulus to thought and observation. Dr. Romanes, in the closing years of his life, did all he could to bring about the foundation of an establishment for testing experimentally the various hypotheses concerning evolution, but without much success. A few observers have been doing excellent work, but the great majority of working naturalists appear to pay little attention to theoretical considerations, and so lose the opportunity of contributing valuable evidence to throw light on controverted questions.

Under the heading of Isolation it is set forth that this may be of two kinds. In *Apogamy*, or indiscriminate isolation, certain individuals are isolated from their fellows without regard for any peculiarities they may possess; in *Homogamy*, on the other hand, the isolated individuals are isolated because they differ from the rest. Natural selection gives rise to *Homogamy* by preserving certain individuals having desirable peculiarities, thus isolating them from those which, lacking those characters, perish. Any form of *Homogamy* must cause a change of type, and thus constitutes a step in evolution. *Apogamy*, strictly speaking, would not cause any change; but as no two portions of a species are entirely alike, in practice it becomes converted into a slight form of *Homogamy* and in time change results. This is most likely to occur when the separated portion is very small, as the average of a few individuals is less likely to resemble that of the whole species than the average of, say, half the species.

It is set forth that there are two forms of evolution, the *monotypic* and the *polytypic*. Natural selection, it is stated, can only cause monotypic evolution; therefore to explain the multiplication of species in space we must call in the aid of other forms of isolation. One potent cause of isolation is said to be *Physiological Selection*, *i. e.*, the segregation of sets of individuals which are fertile with one another, but wholly or partly sterile with the rest of the species.

All these matters are discussed in detail, with many quotations from previous writings. On p. 41 it is remarked that "against the view that natural selection is a sufficient explanation of the origin of species there are two fatal difficulties: one, the contrast between natural

species and domesticated varieties in respect of cross-sterility: the other, the fact that natural selection cannot possibly give rise to polytypic as distinguished from monotypic evolution." The author adds: "Now it is my belief that the theory of physiological selection fully meets these difficulties."

To the present writer, these objections to the sufficiency of natural selection seem not to carry weight, but the matter can only be suitably tested by observation. In the first place, it remains to be shown that polytypic evolution, in the sense intended by Romanes, occurs commonly in nature. Cases are cited in which different species of plants appear to be originating in the same area, but it is by no means proven that they did not originate in different localities and have since intermingled. And even if they have been confined from the beginning to an apparently uniform environment, it will be very hard to prove that the uniformity is real, so that there is no opportunity for natural selection to act differently on the different parts of the original species. It seems to me that, given diverse conditions of life within a limited area, natural selection may operate not only to bring about the division of a species into two or more, but also sterility between them. Let us take the case of such grasshoppers as are found on the sandhills of New Mexico. Some are green and live on the herbage; others are light brown, the color of the ground on which they commonly rest. Each kind will gain some advantage from its color, combined with its habits. Suppose that these are still mutually fertile varieties of one species, the greenish and brownish specimens will cross, and the formation of two races will be hindered.* But there will be variations in fertility, and those which are most fertile together, and at the same time of identical colors, will have an advantage. Hence the correlation of, say, greenness with certain variations of the reproductive organs, will be seized upon by natural selection and perpetuated. Even in ordinary monotypic evolution those individuals which are specially fertile *inter se*, or infertile with those unlike them, and *at the same time possess beneficial characters*, will have an advantage, and the peculiarites of the reproductive organs will be increased through natural selection. Another case is that in which two varieties, mutually fertile, have originated in different localities, but afterwards occupy the same territory. When they meet (as has been actually observed in some cases) hybrids, or mongrels, will be formed all along the line, and it appears as if the peculiarities of each form will eventually be lost. But any small percentage of either variety which has in common some variation of the reproductive organs, leading to physiological isolation, will be left alone to represent the original variety; and as that variety is fitter to survive than the mongrel it will supplant it, and we shall have a species which is infertile with its allies. That it will be infertile with all, or nearly all, its allies is probable because the variations of the reproductive organs are so numerous and so diverse that it is not likely that exactly the same sort of variation will be selected in any two cases.

Thus, while natural selection might employ physiological (more properly, sexual) isolation in the formation of species, it is not quite apparent to me that such isolation would of itself cause divergence. For while sexual isolation would be homogamy as regards that variation —which is by itself the reverse of beneficial—it would be apogamy as regards other variations, since it is not shown that it is correlated with any particular modifications of other kinds. So the isolated individuals, having no advantage, but some disadvantages from their isolation, would tend to be eliminated rather than to increase, owing to the operation of natural selection.

As telling against the necessity for natural selection in the formation of species, Mr. Gulick's statements regarding the land-shells (Achatinellidæ) of the Sandwich Islands are quoted. In these islands it appears that almost every valley has a distinct variety or species, and yet the conditions of existence are apparently the same in at least many of the localities.* Mr. Gulick considers

* Unless there arises a green and brown dichroism within specific limits, as in one species known.

* I have never been to the Sandwich Islands, but can testify that in Jamaica, which also has a remarkably varied molluscan fauna, there are many different conditions of soil, moisture, vegetation, etc., consti-

the distinctions to be due to isolation, without any reference to utility. Suppose a variable type to occupy a valley, A. A few examples wander to valley B and start a colony. Their average is not the same as that of the whole population of the place whence they came; hence the colony will differ more or less, from the start, from the parent race. If this difference is not harmful it will be perpetuated.

The proposition that natural selection can have nothing to do with these changes seems to need examination. It is possible, for example, that when birds have got used to eating variety A in valley A they will not so readily observe and attack a different variety in the neighboring valley B. On crossing into B they might certainly be expected to look for and first attack examples similar to those they had before eaten; hence the new variations would be neglected and get some advantage. Another point is that in a variable species certain individuals will be selected by reason of characters which are, perhaps, not visible externally, *e. g.*, the ability to digest a new sort of food. When these individuals are selected out of many, in the home of the species, they will probably be of diverse varieties, and so no special color-strain, for example, will arise. But let a few examples migrate, and of these only a few survive, it is probable that these survivors will have correlated with their useful characters certain others which are not in themselves valuable.

Much more might be said, but these few criticisms will serve to indicate the problems discussed in the work; and, it is hoped, to suggest lines of observation to those who can help to give us knowledge in place of hypotheses.

T. D. A. Cockerell.

Mesilla Park, New Mexico,
March 25, 1898.

tuting different environments for the snails. The Sandwich Islands are elevated, and it is quite certain that the greatest precipitation of moisture must occur at the higher levels, and on the side of the islands first reached by the prevalent winds. On sloping ground there must also be marked differences of sunlight; and, in short, it may be regarded as certain that the Sandwich Islands valleys do not offer identical conditions.

Penikese; a Reminiscence by One of Its Pupils. Albion, N. Y. 1895. Pp. 95. Price, $3.00.

This is a work dedicated by an unknown author 'To all to whom the memory of Penikese and its Master is dear.' We note in the preface that 'the material of which this little volume is composed furnishes the apology which its author would make for its appearance,' and that 'it seems best no longer to withhold its pages from the public.' The material does not furnish an apology; what the public has done to provoke its publication is not stated, and unsuspecting librarians who may be inspired with everything that bears the name of Penikese should hesitate before placing their orders.

The first chapter, 'The Journey,' is largely devoted to a description of a New England hay field and the antics of a sunbeam in an obscure New Bedford hotel. In the second chapter we learn how 'two score and ten specialists' met together 'on this desolate island,' how they scrambled for their baggage, and how the author took a nap, and what he dreamt, on the afternoon of his arrival. In chapter five the general details of the laboratory are discussed. The author tells us that there were 'bottles of alcohol, sea water, glycerine and other preserving fluids;' how there were 'the remains of a skate fish with the brains exposed' to show 'the five pairs of nerves and their surroundings exactly as they exist in nature;' how the snails 'lay their eggs, in large numbers, bunched together and sticking to each other;' how 'snails' eggs are opaque and white, being longer than broad.'

Writing of one of the leading naturalists, the unknown author says: "Sometimes he tells us about that most wonderfully curious appendage of the bivalves or the lamellibranchs, the crystalline style, and of how it has no attachment to body; this leads to an investigation, and our discoveries are marvelous."

Further on we read as follows: "Ciliary motion ten foot square would exert a force equal to ten tons." * * "One species floats on the surface of the ocean when it is calm. * * specimens, *specimens*, *specimens*, EVERYWHERE. Our professors lecture to us of nothing else; our time is spent in securing and dissecting them." * * "It is from such sketches of our lectures as

those just given that the reader will obtain a glimpse, faint and imperfect though it may be, of a single day's doings at Penikese."

The description of the Physalia is unique and especially good: "As we have no specimen before us, let us try, through the medium of the '*dead* languages,' a little induction *a posteriori*, and discover, if we can, *what* our specimen is really like."

"At first sight, the Portugese man-of-war would put one in mind, as the name suggests, of an immense bubble of air." * * "It stings us with an electric stroke." * * "The true home of this living, floating island is in the Gulf of Mexico," etc. The author says he found a specimen, which 'threw off a whole tankful of young, which went paddling around everywhere of their own free will, as happy as clams at high water.'

Aside from a few errors in spelling and the misstatement of a few well-known historical facts, we offer no further adverse criticism, though in closing we cannot refrain from quoting from page 64, where the author says: "Well do I remember how often Professor Agassiz urged us to read only the best of books." * * * "He cordially detested the ordinary books upon scientific subjects. At one time, in a paroxysm of rage at these 'would-be scientists,' he exclaimed: 'They are mere compilations of persons unfamiliar with science, who mix the false and the true.' Alas, shall we ever again meet with his equal, as teacher and pupil and brother combined!"

H. C. B.

NOTE: Since writing the above review we have examined an advertising circular which announces 'A Memorial Volume of Penikese,' the same as the above mentioned work. We quote from this circular as follows: "About two years ago I completed a contract for the printing of my 'Penikese Island;' unfortunately, before the pages were finished, the parties with whom I contracted became bankrupt. I have just succeeded in rescuing the sheets from the wreck at an expense of something over $100. The work is in signatures, is on tinted paper, hand-made expressly for the purpose, comprises about 100 pages, and only 100 copies were printed. These will be sent to the old teachers and scholars and their friends only if they can be found. Price, postpaid, $3.00. Send check or postal order to W. A. Stearns, Atlanta, Ga."

Exploration of the Air by Means of Kites. I. *Kites and Instruments*, by S. P. FERGUSSON. II. *Results from the Kite Meteorographs and Simultaneous Records at the Ground.* III. *Discussion of the Observations*, by H. HELM CLAYTON. Reprinted from the Annals of the Astronomical Observatory of Harvard College, Vol. XLII., Part I. Cambridge, 1897. 4to. Pp. 43–128. Pls. VII.

Ten years ago no one would have thought that a serious piece of scientific work could have for its subject the exploration of the air by means of kites. Yet, as has been frequently pointed out in this JOURNAL during the last two years, the records obtained from the free air, at altitudes up to two miles above the earth's surface, by means of meteorological instruments attached to kite lines, have given extremely valuable results. So much so, indeed, has this been the case that *kite meteorology*, if we may so term it, has come to be recognized as an increasingly important branch of the general science of meteorology. Occasional reference has been made in these columns to the kite work done at Blue Hill Observatory, under the direction of Mr. A. Lawrence Rotch, by Messrs. Clayton, Fergusson and Sweetland. This work is now well known, but until the present time there has been no complete report upon it.

The publication, in the Annals of the Harvard College Observatory, of a monograph on *The Exploration of the Air by Means of Kites*, marks an epoch in the history of modern meteorology. The Weather Bureau issued, in 1896, a valuable Bulletin (by Professor Marvin) entitled *Kite Experiments at the Weather Bureau*, but this was concerned chiefly with the construction of kites and the forces acting on them, and did not include a discussion of the instrumental records obtained by means of the kites.

It is impossible, in a brief notice, to do the Blue Hill kite report justice. There are three chapters in all. The first, on *Kites and Instruments*, is by Mr. S. P. Fergusson, and deals with

the details of construction of the kites and of the meteorographs. The second chapter concerns the *Results from the Kite Meteorographs and Simultaneous Records at the Ground*, and includes complete tables containing data as to the altitudes of the kites; the temperature of the air at the kite, on Blue Hill and in the valley at the base; humidity and wind velocity at the kite and on the hill, etc. The third chapter is by Mr. Clayton and is a discussion of the records. If anyone has had any doubts as to the scientific quality and as to the value of the kite work done at Blue Hill, a glance at this chapter will amply suffice to dispel his doubts. A laborious collection of data and a careful study of these data have clearly preceded the final writing of this discussion.

It would detain us too long were we to call attention to the many noteworthy points which Mr. Clayton has brought out. Only a few can be mentioned. The anemometer records show that between the average heights of 100 and 400 meters the rate of increase of velocity for each 100 meters of greater altitude is 0.6 mile per hour, this being a slower increase than has been found to obtain in the cloud levels higher up above the top of Blue Hill. The change in direction of the currents aloft, shown by the shifting of the kites during their ascents, is interesting. The prevailing tendency is for the kites to indicate currents from the west aloft, no matter with what surface direction of wind they left the ground. The temperature results are naturally the most important. It appears that the diurnal range of temperature diminishes rapidly with increasing altitude in the free air, and almost disappears, on the average, at 1,000 meters.

The variations in change of temperature with altitude are classified into six types, all of which are striking. To mention only three, type 4, which Mr. Clayton calls the *warm wave* type, is produced when a warmer current overflows colder air, and in a majority of cases, when found below 2,000 meters, is caused by the approach of a warm wave, which, moving faster in its upper strata than in the lower, overflows the colder air aloft before it is itself felt as a warm wave on the earth's surface. Such a type, when its existence is known, makes possible the forecast of a warm wave with a high degree of certainty. The *cold wave* type (type 5) shows a fall of temperature with increase of altitude at the adiabatic rate of unsaturated air, above 300 metres, while the night curve shows a rapid decrease of temperature with increase of altitude from the ground upward, these conditions making it possible for showers to occur if the lower air is damp enough. The connection of tornadoes and thunderstorms with falls in temperature is well known, and these results throw much light on the vertical temperature gradients at times of such disturbances. The sixth type is, perhaps, the most interesting of all. It shows the same or nearly the same temperature from 400 to 1,400 metres or more, and is found prevailingly in anticyclones. This is of special importance because of its bearing on the Hann, or driven, theory of anticyclones; for if, as generally stated, the warm and dry air at considerable altitudes in anticyclones is the result of warming by descent and compression, the vertical temperature gradient in anticyclones should be at the adiabatic rate, or nearly at that rate. No adequate explanation of these apparent contradictions appears as yet, and further temperature data from the free air in anticyclones will be awaited with interest.

The above are only a few of the many noteworthy points which are brought out in this valuable monograph. Meteorologists are under a debt of gratitude to Mr. Rotch for his liberality in conducting the experiments, and to Mr. Clayton for the masterly way in which he has dealt with the data under discussion.

R. DeC. Ward.

Harvard University.

Outlines of Descriptive Psychology. By George Trumbull Ladd. New York, Charles Scribner's Sons. 1898. Pp. xi+428.

The present volume covers substantially the same field as the author's 'Psychology, Descriptive and Explanatory,' but is intended rather as a text-book than as a treatise for advanced students. It is not a mere abridgment of the former; every point has been reviewed and the expression revised, so that few sentences read exactly alike in the two works.

The arrangement of chapters and the development of the subject is practically the same in both, as might be expected, in view of their common authorship. But further than this, whole phrases and sentences are to be found everywhere which furnish parallel readings with but slight verbal alterations. A frank acknowledgment of this parallelism, though not a matter of primary importance, might have been of considerable assistance to some readers. On the whole, the verbal changes referred to are in the interest of conciseness and smoothness of diction, and the limiting of discussion in the 'Outline' to a few salient points makes the presentation clearer and more acceptable to the ordinary student. Assuming the general identity of standpoint of the two works, we need do no more than point out their most striking differences. In the earlier work the chapter on Impulse, Instinct and Desire is placed after the treatment of perception, reasoning and the emotions, and just before the will. In the 'Outline' it is advanced to the first place in the part devoted to the Development of Mental Life, so that it precedes even the discussion of Perception. This is a notable indication of the larger prominence which the 'motor consciousness' is obtaining in psychology.

A chapter is added in the 'Outline' on the relation between mind and body. The author eliminates the metaphysical side of the topic, which he has discussed in his Philosophy of Mind, while the treatment of the scientific aspect may be considered an advance on the position taken in his two works on physiological psychology.

The genetic standpoint is emphasized more than in any of Professor Ladd's previous works, while laboratory psychology is given more space and greater importance, relatively, than in the larger descriptive psychology. Diagrams occur frequently to illustrate both particular experiments and curves of general results. In connection with the latter, it should be noted that the diagrams on pages 84 and 85, which are given for the purpose of exhibiting the difference between Weber's and Fechner's statements of the psycho-physical law, are rather misleading; the axes of sensation and stimulus are reversed in the two drawings, making the curves difficult of comparison, and, moreover, the interpretation of the horizontal distances (sensation increments) in the first diagram is somewhat open to question. The psycho-physical law itself is stated (in italics) as follows: "For any given class of sensation the least noticeable difference is a constant fraction of the sensation" (p. 83). A slip of this character is unusual in so careful a writer as Professor Ladd.

It is scarcely in place here either to approve or to criticise Professor Ladd's general positions, which are too well known to call for any special review. The distinction between processes and development of mental life forms the basis for a two-fold division of the work. The author reminds us in his preface that experiment has been most frequently and successfully applied to the elementary phases of mental life, and that it has accomplished but little in the higher types of psychical process. The same position is maintained in the body of the work, where references to experimental results are largely confined to the first part.

As indicated by the title, the 'Outline' is a 'descriptive' treatment of psychology. The omission of detailed 'explanatory' portions, which appear in the larger work, make it available for general class-room work, and in this sphere it will doubtless prove of extreme value. Page references to well-known authorities are given at the end of each chapter, supplying a more detailed treatment for those who wish it.

H. C. WARREN.

SCIENTIFIC JOURNALS.

American Chemical Journal, April. 'An Investigation of some Derivatives of Orthosulphobenzoic Anhydride:' By M. D. SOHON. The author studied the action of alcohol, phenols, ammonia and amines on the anhydride and obtained esters, phthaleins and other derivatives which were well characterized. A series of sulphonic acids isomeric with the sulphaminebenzoic acids was obtained. 'Iodometric Estimation of Tellurium:' By J. F. NORRIS and H. FAY. The authors oxidize the tellurous acid with potassium permanganate, estimate the excess of the latter with potassium iodine and sul-

phuric acid and determine the iodine set free by sodium thiosulphate. 'The Relation of Trivalent to Pentavalent Nitrogen:' By A. Lachman. Preliminary study of the reactions of nitrosamines. 'On Paramethoxyorthosulphobenzoic Acid and some of its Derivatives:' By P. R. Moale. 'Decomposition of Paradiazoorthotoluenesulphonic Acid with Absolute Methyl Alcohol in the presence of certain substances:' By P. R. Moale. The decomposition was studied in the presence of sodium methylate, ethylate, potassium hydrate, ammonia and aniline. 'Parabenzoyldiphenylsulphone and related compounds:' By L. C. Newell. 'The Action of Ethylic Oxalate on Camphor:' By J. B. Tingle.

J. Elliott Gilpin.

SOCIETIES AND ACADEMIES.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 77th meeting, held in Washington, D. C., on April 13, 1898, Mr. J. A. Taff, U. S. Geological Survey, discussed the 'Geology of the McAlister quadrangle.' This quadrangle covers a quarter degree in northwestern Choctaw Nation, Indian Territory. Its geology is practically a duplication of the western Arkansas coal field and older Carboniferous rocks. The coal-bearing rocks, shale, sandstone and coal occupy the northwestern half of the quadrangle and are nearly 6,500 feet thick. Two productive coal beds have been developed. One, the Hartshorn or Grady coal, is at the base, and the other, the McAlister coal, is about 1,350 feet higher in the series. Each is about four feet thick and produces a good strong coal. Sandstone, shale and limestone occur below and south of the coal-bearing rocks and have an aggregate thickness of nearly 1,800 feet. The structure is Appalachian. That of the coal field is canoe-shaped synclines and unsymmetrical anticlines. The rocks south of the coal field are greatly faulted and intensely folded. The faults are overthrust and the folds overturned toward the north. The displacement of the greater faults are estimated to be from 7,000 to 10,000 feet.

Under title, 'The Probable Age of the McAlister Coal Group,' Mr. David White presented a synopsis of the results obtained from a study of the fossil plants of the McAlister, I. T., coal field. The flora of the Grady or Hartshorn coal he finds to indicate a reference to the 'Lower Coal-bearing Division' of Winslow, or the basal portion of the Upper Coal Measures of Branner and Smith, in Arkansas, and a stage near the base in the Allegheny Series of the Ohio-Pennsylvania bituminous regions. The plants of the McAlister coal, about fifteen hundred feet above the Grady coal, assure a correlation with the 'Upper Coal-bearing Division' of Winslow, in Arkansas, a stage, perhaps near the Lane Shales, in the lower half of the Missourian, in Arkansas, probably below the Pittsburg coal in Pennsylvania, or near coals F or G of the Northern Anthracite field. Vegetable remains, collected by Messrs. Taff and Richardson from an horizon about two thousand feet above the McAlister coal, constitute a distinctly Coal Measures flora, without any characteristic Permian species, and bespeak a remarkable expansion of the Upper Coal Measures, or Missourian, in the Indian Territory coal field, such as is perhaps comparable to the great dialation of the Lower Coal Measures in the Central Appalachian region.

The last paper was by Mr. H. W. Turner on 'The Succession of the Igneous Rocks of the Sierra Nevada.'

In Jura-trias time in the northern Sierra Nevada volcanoes poured forth acid lavas, meta-rhyolites and meta-dacites. These acid lavas were followed by more basic lavas, meta-augite-andesites (augite-porphyrites). The succession is here clearly: first, acid; second, intermediate to basic lavas. During nearly all of Cretaceous time, and perhaps also during the Eocene, the volcanic forces of the Sierra Nevada were quiescent. The first Teritary eruptions of large volume of which there are records were rhyolite. After another but shorter period of rest, during which the rhyolitic lavas were partly eroded, the volcanoes emitted vast floods of andesite. This succession does not accord with the theory proposed by Iddings, that the first eruption of a given volcanic center are of intermediate lavas followed by lavas more acid or more basic, or both.

Wm. F. Morsell.